

Name: _____ GWID: _____

1. In general, when you design a scientific study to study certain factors (treatments) on a response or outcome, you need to first set the sample size or the number of experiment units for your study.

(1) (10 points) The required component for the sample size calculation is: (circle only one answer)

- A. Expected effect size (the difference that you expect to find between the treatments)
 B. The variability (standard deviation) of the observations.
 C. The desirable power and type I error.
 D. All the above.

(2) (10 points) You have a limited time or cost to finish the study, therefore the power that you choose to plan your study should be: (circle only one answer)

- A. 50-60% B. 60-70% C. 80-90% D. > 95%

2. In a single factor study, assume we the number of levels for the factor is r and the values of the response (observations) are denoted by Y_{ij} , $i = 1, \dots, r$; $j = 1, \dots, n_i$.

(1) Please write down the two formulations for the ANOVA model:

(10 points) Cell means model $Y_{ij} = \mu_i + \epsilon_{ij}$

(10 points) Factor effects model $Y_{ij} = \mu. + \tau_i + \epsilon_{ij}$

(2) Based on your data (Y_{ij}), write down the formula for

(10 points) the best estimator for the factor level means μ_i is $\bar{Y}_{i.}$ (sample mean in factor level i)

3. A hospital researcher used a completed randomized design to study 3 dose levels of a drug therapy to treatment patient's high blood pressures. 36 patients with hypertension were recruited and randomized into the 3 drug dose levels (12 patients in each dose group). After the study, the researcher ran the ANOVA analysis and generated the following ANOVA table:

Source of variation	SS (sum of squares)	df	MS (mean squares)	Test statistic (F^*)
Between doses	300	2	150	50
Error	99	33	3	
Total	399	35		

(1) (10 points) State the null and alternative hypothesis in the ANOVA analysis.

$H_0: \mu_1 = \mu_2 = \mu_3;$

$H_a: \text{Not all } \mu_i \text{ are equal.}$

(2) (20 points) Please fill in the missing components for SS, df, MS, test statistic in the ANOVA table.

(3) (10 points) Under null H_0 , what distribution the test-statistic F^* is distributed as? $F(2, 33)$.

(4) (10 points) The p-value of the test < 0.0001 , what will be conclusion that researcher can state based on these results? The mean blood pressures were different for the three dose groups. Because this is a completely randomized study, it also suggests different drug doses result in different treatment effects.