Biometry Take Home Exam 1
Spring Semester 2010

Name:_____

1. You are developing a dissertation project on phenotypic plasticity in body size at maturity in the sexually dimorphic livebearing fish, *Limia perugia*. To get some pilot data, you enlist the help of a Bio 395 student, who you instruct to take a brood of neonates, and put each fish in its own aquarium. Half of the fish are assigned Small aquaria (2.5 gallons), and half are assigned to Large aquaria (10 gallons), though some die before reaching sexual maturity. The baby fish reach sexual maturity in 6 months, whereupon the student presents you with the following data set.

| Sex$ | TankSize$ | LogMass |
|---|---|---|
| Male | L | 2.204972 |
| Male | S | 2.191654 |
| Female | L | 2.386926 |
| Female | S | 2.327278 |
| Female | S | 2.979095 |
| Male | L | 1.931521 |
| Female | S | 2.61374 |
| Female | L | 2.821379 |
| Male | S | 1.272566 |
| Male | L | 1.978239 |
| Male | S | 1.759581 |
| Female | L | 3.272606 |
| Male | S | 1.229641 |
| Female | S | 2.381396 |
| Male | S | 1.940179 |
| Female | S | 2.255493 |

What analysis would you perform on these data and why? What are the results of your analysis? What are the effect sizes and partial effect sizes for Sex and Tank Size? What is the power of your test for each effect? What sample size would you need to achieve a power of 0.80?

2. You are studying dominance behavior between large versus small female mosquitofish, which chase each other as they compete for food. Your design is to place one large female and one small female in each of 20 tanks, and conduct 10-minute focal female observations on each female in each tank. You generate the following dataset (next page, chase per minute data were log transformed).

Analyze the data two ways: 1. as a one-way ANOVA with Size as your treatment variable; and, 2. As a two-way ANOVA with Size as a fixed effect and Tank as a random effect. What effect does including Tank in your model have on your test of your fixed effect, and on the effect size of you r fixed effect? What are the differences in power between these two analyses? Why do you think this is the case?

3. Compare and contrast the 3 basic models for 2-way ANOVA, Model I, Model II, and Mixed Model, in terms of their assumptions, expected mean squares (and what is tested over what), and how their results are interpreted.

4. What are the relative advantages and disadvantages of Nested versus Randomized Block designs? When might you use each one in your own research?

5. You've got 8 growth chambers, and you want to test the effects of photoperiod (short versus long) and fertilizer (control soil versus fertilized soil) on growth in *Arabidopsis*. Each growth chamber has room for 10 plants. What would be your experimental design? Lay it out as an ANOVA table, and identify your sources of variation, degrees of freedom, expected mean squares, and F tests (what's tested over what). Assuming partial eta-squareds of 0.10, do you think you have sufficient Ns to achieve 0.80 power?

6. In the Nested ANOVA we covered in class…

Male Harassment = Male Density + Pools(Male Density) + Error

…what is the difference between testing Males over Pools(Males) versus doing an ANOVA on wading pool means? (Dataset attached)

| Tank$ | Size$ | Chase |
|---|---|---|
| A | l | 0.43 |
| A | s | 0.22 |
| B | l | 0.87 |
| B | s | 0.48 |
| C | l | 0.87 |
| C | s | -0.18 |
| D | l | 0.99 |
| D | s | 0.52 |
| E | l | 0.22 |
| E | s | 0.00 |
| F | l | 0.85 |
| F | s | 0.37 |
| G | l | 0.30 |
| G | s | 0.12 |
| H | l | 0.70 |
| H | s | 0.37 |
| I | l | 0.30 |
| I | s | 0.00 |
| J | l | 0.87 |
| J | s | 0.52 |
| K | l | 0.30 |
| K | s | 0.12 |
| L | l | 0.87 |
| L | s | 0.12 |
| M | l | 0.48 |
| M | s | 0.60 |
| N | l | 0.85 |
| N | s | 0.37 |
| O | l | 0.43 |
| O | s | 0.30 |
| P | l | 0.73 |
| P | s | 0.48 |
| Q | l | 0.12 |
| Q | s | 0.12 |
| R | l | 1.07 |
| R | s | 0.56 |
| S | l | 0.12 |
| S | s | -0.18 |
| T | l | 0.92 |
| T | s | 0.56 |