This portion of the final is worth 70% of your total grade for the final. The other 30% will be from a multiple choice section to be completed during the regular scheduled time for the final for the respective class. The deadline for submission of this portion of the final is the day and time your class meets to complete the in-class portion of the final.

The combined worth of the multiple choice section and this section is 40% of your class grade.

The point value of each question (and part of question) is listed by the question.

The deadline for submission is the day of the final for your class (before completing the multiple choice part of the exam).

Follow these instructions:

- Make sure your name is clearly indicated at the top of the first page
- Throughout this final, as with the midterm, please copy the relevant output from SPSS into your typed response to the question wherever needed.
- Throughout the final, assume an α-level of .05.
- Remember from the weekly exercises since the midterm that we should always strive to give estimates of both significance and meaningfulness of statistical effects. And you should know what those terms mean. Apply this guideline to all your answers.
- GIVE THOROUGH ANSWERS TO ALL PARTS OF ALL QUESTIONS (brevity is dangerous in stats)
- Do this final on your own, as per the midterm. Minimum Penalty for copying will be a 0 on the relevant part of the exam.
- Please note all this data is made up, fictitious, of no meaningful relation to the real world...but you are supposed to pretend it’s real for the purposes of this exam.

**Question 1:** Percent of people wearing shoes to work, 1990 and 2010, broken down by city.

**Description:** The percentage of people wearing non-athletic shoes to work was assessed two times by giving a simple survey to the same cohort of people across each of 21 cities on two separate occasions, once in 2000 and once in 2010.

**Number of cases:** 21.

**Variable Names:**
1. Percent of people wearing non-athletic shoes to work in 2000.
2. Percent of people wearing non-athletic shoes to work in 2010.

**Problems:**

i. Do the percentages differ? State the outcome of the analysis in the format recommended in Cronk. (5 points)

ii. Now assume the two percentages reflect data gathered from the same cities, but different people are surveyed on each occasion (that is, the people responding to the survey are different on each occasion). Conduct the analysis that is appropriate now. Has the significance level changed? (5 points)

iii. Explain why these two tests might differ in their level of significance. (10 points)
Question 2: Shoe Type, Smell, and Comfort.
Description: The amount of foot odor and the comfort ratings of the same shoes were taken from an equal sample of three groups of people, each of whom had been wearing a particular type of shoe for a month.
Number of cases: 51
Variable Names:
1. Type: Type of Shoe (sneakers; normal shoes [flat, casual wear]; vibram 5-fingers).
2. Comfort: Degree of pain caused by shoes (0 = no pain; higher numbers indicate increasing discomfort).
3. Smell: Smelliness of feet after wearing shoes (0 = no odor; higher numbers indicate increasing smelliness).

Problems:
   i. What make of shoe would you choose if you were willing to put up with the pain of a shoe but couldn’t stand having smelly feet? Report the findings of the statistical analysis as per Cronk. (15 points)
   ii. Now imagine that your primary concern is pain. Now what would be your choice? Again, justify your choice with appropriate statistical evidence. (5 points)

Question 3: Shoe comfort and arch size.
Description: Some researchers saw the results of the data for the first question, and were particularly interested in the comfort ratings for the two types of shoe. They looked up some research on flat-footedness, or pes planus, and thought it might be worth considering the role of flat-footedness in the comfort ratings, as well as shoe type. So, they took 36 people and split them into 3 groups according to the size of their foot arches (arched, moderately arched, and flat), and then randomly assigned half of each resulting group of 12 individuals to normal sneakers, and half to Vibram five-finger shoes. They then had them wear their new shoes for a week, and then took comfort ratings using the same scale as used in question 1.
Number of cases: 36
Variable Names:
1. Shoe type: 1 - normal sneakers; 2 – Vibram five finger shoes.
2. Arch size: 1 – flat foot; 2 – not so flat foot; 3 – normal arch size.
3. Comfort: Degree of pain caused by shoes (0 = no pain; higher numbers indicate increasing discomfort).

Problems:
   i. Run one analysis that examines the effects of each variable alone and also in combination with each other. Is the homogeneity of variance assumption violated or not? Summarize the findings for this analysis, performing follow-up tests on whichever statistical effects are necessary, and state all significant differences you find. Interpret these differences, if any. Which effect(s) should be paid most attention to, and why? (15 points)
   ii. Why might you obtain a significant effect from an analysis of variance, yet not obtain any significant differences from a follow-up test? (5 points)
**Question 4: Shoe durability by type of shoe.**

**Description:** 44 individuals were recruited to take part in a study to test the durability of Vibram five finger shoes in comparison to regular sneakers exposed to similar use. Twenty-two people were assigned to a regular sneaker condition, while 22 others were assigned to wear the Vibram shoes. All participants took part in regularly scheduled running and walking exercise bouts, 4 times per week, until either of their shoes was deemed “no longer roadworthy,” according to expert opinion. The total number of weeks until being worn out was recorded for each participant.

**Number of cases:** 42

**Variable Names:**
1. Group: Regular running shoes (1) vs Vibram 5-finger shoes (2).
2. Outcome: Number of weeks until shoes show unacceptable level of wear.

**Problems:**

i. Using an $\alpha$-level of .05, does the type of shoe make a difference to the number of weeks the shoes last? State the outcome of the analysis in the format recommended in Cronk. (5 points)

ii. Now test each of the regular running shoe and vibram groups (in separate analyses) against an assumed population mean of 84 weeks.
   a. State the results of these analyses (5 points)
   b. Is the greatest deviation from the population mean accompanied by the smallest probability value (significance value)? Why might the smallest deviation have the lowest probability value? (10 points – full answers get more points than brief ones)

**Question 5: Theory**

i. Explain how the method of measuring spread differs, but the actual test statistics remain comparable, across the test statistics for each of the following statistical procedures: z-score, one sample t-test, independent samples t-test, paired samples t-test (10 points).

ii. Explain how between and within group sums of squares are used by a one way ANOVA to arrive at an assessment of the relative size of a treatment/group effect (10 points).