Student Version:

Title: "Easy exercise"

Abstract: You are investigating a claim you recently saw on late night tv, claiming there was a pill that could increase cardiac performance without any evidence. You design and carryout an experiment investigating the hypothesis that the drug will increase cardiac performance, in addition to this you investigate the effects of the exercise routine on the efficacy of the pill. You will be provided a spreadsheet with data collected from the experimental protocol. In this assignment you will analyze the data and determine whether the drug, meets expectations. This project will be used to reinforce concepts learned from the cardiovascular physiology component of General Physiology.

Case study passage:

A recent advertisement on late night television advertised a miracle pill that claimed it could improve cardiac performance (cardiac output for the expert) during exercise compared to those who didn't take the pill, all while reducing heart rate. You notice at the end of the commercial a disclaimer ran across the bottom of the screen that read "Results may vary based on each individual. Not FDA approved". Being the skeptic, you are you decide to carry out an experiment investigating their claims.

After getting approval through the Institutional Review Board at your university, you decide to collect data at various locations in town, but mainly on campus. In addition to the efficacy of the drug you design your experiment to see if exercise routine has any impact on the validity of the claim. You include on your participant survey the exercise routine of each participant. You categorize these as: zero exercise per week, 1-2 days of exercise per week, 3-4 days of exercise per week, 5 or more days of exercise per week. You will need to collect data at the following four time points: at rest, a control measurement following exercise, following drug treatment, and following four months of endurance training. You will complete these measurements over the course of a year, four months in between each meeting see table I for details of each meeting. You will measure heart rate and stroke volume using impedance cardiography and calculate cardiac output for each participant.

Table I: Meeting summary and description of events.

Meeting	Description of events
1: Introductory	Participants will complete background survey (See attached) and sign waiver. Measure resting heart rate and stroke volume.
2: Control cardiac performance after moderate exercise	Measure heart rate and stroke volume following 25 minutes of moderate running.

	Administer "Miracle drug" at end of meeting to all participants.
3: Moderate exercise after taking miracle drug	Measure heart rate and stroke volume following 25 minutes of moderate running.
4. Moderate exercise following 4 months of training without the miracle drug	Measure heart rate and stroke volume following 25 minutes of moderate running at least 3 days per week

See the associated spreadsheet with the data set and analyze using Microsoft Excel.

Instructions for students:

Duration: The project should require 1-2 weeks to complete and require 1-2 50-minute classroom periods. Students will be required to turn in their assignments three weeks after the assigned date.

Deliverables:

Students will be required to turn in a "lab report" style.

With the project write up you must turn in the associated spreadsheets with the calculation required (See below).

Lab report write up:

You will prepare a lab report for the data. Your lab report must include an introduction, results and discussion section.

Items to include in your introduction:

1. Why you are measuring the impact of exercise and the effectiveness of the drug?
2. Why are you (the researcher) measuring heart rate and stroke volume to test the claims of the drug presented in the advertisement?
3. What is the role of cardiac output? How do you expect cardiac output to be affected when measured immediately following exercise? How would exercise affect cardiac output when measured at rest?

4. State hypothesis toward the end of the introduction and briefly mention how measurements are being collected.

Items to include in your results section:

Using Microsoft excel you will need to complete the following:

1. Calculate averages and standard deviation for heart rate and stroke volume for each category.
2. Significant figures will depend on the variable reported.
   a. Heart rate needs to be rounded to the nearest whole number.
   b. Stroke volume needs to have two significant figures
   c. Cardiac output needs to have two significant figures
3. Calculate cardiac output for each participant and calculate the average and standard deviation for each exercise group.
4. Generate 3 bar charts from averages for heart rate, stroke volume, and cardiac output. Include error bars that represent the standard deviation for each measurement collected. In each figure you should have all exercise routines presented.
5. Run statistics on the provided on raw data.

   Compare values between and within exercise categorization using a paired t-test:

   > Separate paired t-tests should be used to compare each measurement for **HR, SV, and CO within each exercise group**. This is a two tailed type I t-test. More information regarding paired t-test can be found below:
   >
   > http://www.real-statistics.com/students-t-distribution/paired-sample-t-test/

   > 1. Resting measurement vs. Control measurement
   >
   >> Example: Resting heart rate vs. control heart rate for the zero exercise
   >>
   >> Repeat for stroke volume and cardiac output for each exercise group
   >
   > 2. Control measurement vs. Measurement after drug
   >
   >> Example: Control Heart rate vs. Impact of drug on heart rate for the zero-exercise group.
   >>
   >> Repeat for stroke volume and cardiac output for each exercise group
   >
   > 3. Control measurement vs. Measurement after 4 months of training

Example: Control heart rate vs. Heart rate after training for the zero-exercise group.

Repeat for stroke volume and cardiac output for each exercise group

4. Measurement after drug vs. Measurement after 4 months of training

Example: Heart rate after drug vs. Heart rate after training for the zero-exercise group.

Repeat for stroke volume and cardiac output for each exercise group.

Separate unpaired t-tests should be used to compare between exercise groups. This test is comparing the impact of exercise on the effectiveness of the drug. You will compare between exercise groups for cardiac output only. This is a two-tailed type II test

Comparisons to make:

1. Cardiac output after the drug between Zero exercise vs. 1-2 day of exercise per week.
2. Cardiac output after the drug between zero exercise vs. 2-3 days of exercise per week.
3. Cardiac output after the drug between zero exercise vs. 4 or more days of exercise per week.

5. In the text you will present the findings of the study, saving discussion until the following section of your lab report. You can include the figures in text or at the end of the document. Figures should have figure captions, axis labels, and figure legends.

Items to address in your data discussion:

1. Present your data succinctly, summarizing the data. Make sure you reference the figures. Interpreting the data. What does it mean?
2. Was cardiac performance affected by the drug compared to the control measurement? Discuss factors that affect cardiac output (Preload, afterload, contractility) and speculate how this pill may have impacted these factors.
3. Did the level of activity affect efficacy of the pill? Explain.
4. How were the resting cardiovascular values affected by level of activity? How were the cardiovascular values affected by exercise when immediately measure after activity? Is this what you expected? Why or why not?
5. Explain the significance of cardiac output, heart rate, and stroke volume during exercise in relation to the data. Explain the impact of the pill on groups with different activity levels.

6. You are calculating cardiac output to gauge cardiac performance. How else could Oxygen delivery to tissues be improved? Are there any tradeoffs associated?
7. What is your conclusion on the miracle drug? Would you recommend people take it to improve physical performance?
8. Regardless of the drug's efficacy, what is required to increase exercise performance in endurance athletes?
9. Did you support the initial hypothesis? Provide enough detail in your response to justify your answer.

Evaluation:

Students will be evaluated based on the completeness and accuracy of their project. All projects must be polished and well written. If errors are present in the analysis or write up, the evaluation of your project will be negatively affected. Refer to the provided rubric for more detail regarding grading.

	A: Great, project meets or exceeds expectations 100-90%	B: Good, minor improvements needed 89-80%	C: Sufficient, multiple aspects could be improved 79-70%	D: Inadequate, multiple aspects require improvement 69-60%	F: unacceptable, Major inadequacies in project. <50%
Introduction **Out of 5 pts**	1. Question being tested is included AND 2. Questions to be addressed are fully answered AND 3. Hypothesis stated toward end of introduction.	1. Question being tested is not included OR 2. Questions are not fully answered, room for expansion on response is evident. OR 3. Hypothesis not clearly stated.	1. Question being tested is not included AND/OR 2. Questions are not fully answered, room for expansion on response is evident. AND/OR 3. Hypothesis not clearly stated.	1. Question being tested is not included AND/OR 2. Questions are not fully answered, room for expansion on response is evident. AND/OR 3. Hypothesis not clearly stated.	No attempt was made to include required items
Results **Out of 10 pts**	1. Cardiac output for all measurements correctly calculated. AND 2. Averages and standard deviation have been correctly calculated for all measurements. AND 3. All required figures are present, and they are summarized and referenced in the results section text.	1. Cardiac output is calculated incorrect for one measurement. AND/OR 2. Averages and standard deviation have not been correctly calculated for one measurement. AND/OR 3. All required figures are present, one is not discussed or referenced in text. AND/OR 4. Standard deviation is absent on one figure.	1. Cardiac output is calculated incorrect for two measurement. AND/OR 2. Averages and standard deviation have not been correctly calculated for two measurements. AND/OR 3. All required figures are present, two are not discussed or referenced in text. AND/OR 4. Standard deviation is absent on two figures. AND/OR	1. Cardiac output is calculated incorrect for three measurement. AND/OR 2. Averages and standard deviation have not been correctly calculated for all three measurement. AND/OR 3. All required figures are present, three are not discussed or referenced in text. AND/OR 4. Standard deviation is absent on three figures. AND/OR	1. Cardiac output is calculated incorrect for four measurement. AND/OR 2. Averages and standard deviation have not been correctly calculated for any of the measurements. AND/OR 3. At least one required figure is absent, figures not referenced in text. AND/OR

	AND 4. Standard deviation is included on figures AND 5. Statistics are indicated through use of symbols on figures. AND 6. Figures are formatted correctly and contain proper title and descriptions. AND 7. Data analysis must be turned in to receive a grade higher than "C".	AND/OR 5. Statistics are not indicated on one figure through use of symbols. AND/OR 6. One figure has formatting errors or does not contain proper title and description. AND/OR 7. Data analysis must be turned in to receive a grade higher than a "C".	5. Statistics are not indicated on two figures through use of symbols. AND/OR 6. Two figures have formatting errors or do not contain proper titles and descriptions. AND/OR 7. Data analysis must be turned in to receive a grade higher than a "C".	5. Statistics are not indicated on three figures through use of symbols. AND/OR 6. Three figures have formatting errors or do not contain proper titles and descriptions. AND/OR 7. Data analysis turned in late.	4. Standard deviation is absent on all figures. AND/OR 5. Statistics not performed. AND/OR 6. Three figures have formatting errors or do not contain proper titles and descriptions. AND/OR 7. Data analysis turned in late.
Discussion Out of 10 pts	1. Data explained correctly in the discussion AND 2. Questions are addressed thoroughly. AND 3. Figures referenced in discussion. AND	1. Minor errors explaining data. OR 2. Questions do not address thoroughly. OR 3. Figures not referenced consistently in discussion. OR 3. Statement regarding hypothesis	1. Major errors explaining data. AND/OR 2. Some questions not addressed. AND/OR 3. Figures not referenced consistently in discussion. AND/OR 3. Statement regarding hypothesis either affirmed or rejection is not present.	1. Little attempt to explain Data. AND/OR 2. None of the questions addressed AND/OR 3. Statement regarding hypothesis either affirmed or rejected is absent.	1.No attempt to explain Data. AND/OR 2. None of the questions addressed AND/OR 3. Statement regarding hypothesis either affirmed or rejected is absent.

	4. Statement regarding hypothesis either affirmed or rejected present.	either affirmed or rejection is not clear.			
Mechanics and grammar **Out of 5 pts**	1. Lab report is well written with minimal errors present. AND 2. Spelling errors are absent.[*] [*]If present the highest grade that can be earned is a "C".	1. Some grammatical errors are present, nothing major. OR 2. Spelling errors are absent.[*] [*]If present the highest grade that can be earned is a "C".	1. Several grammatical errors present. AND/OR 2. 1-3 spelling errors present.	1. Grammatical errors are abundant and obvious. AND/OR 2. 4-5 spelling errors present.	1. Grammatical and spelling errors are abundant. 2. More than 5 spelling errors present.
Out of 30 pts total					