Assignment 2: Foundations of Science SOLUTIONS

Scientific Approach to Knowledge

1. Science is limited to studying those things that can be observed directly or whose effects can be observed. Another way of saying this is that for a phenomenon to be studied by science the phenomenon must have an empirical referent.

2. The requirement that other researchers must be able to replicate a finding for it to have credibility leads to science being self-correcting.

3. In order for a theory to be a ‘scientific’ theory it must be testable.

4. For a theory to be testable it must make predictions.

5. If an experiment based upon the prediction made by a theory shows that the prediction was incorrect, does that prove the theory is false? a: no  b: yes

6. If an experiment based upon the prediction made by a theory shows that the prediction was correct, does that prove the theory is true? a: yes  b: no

Measurement

Identify the measurement scale (nominal, ordinal, rank, cardinal) of each of the following:

7. The numbers marathon runners wear to identify who they are. Nominal

8. Please identify your academic major: nominal

• Education
• Physical Science
• Business
• Social Science
9. How many books did you read this year? **Cardinal**

10. With which political party do you most closely identify? **Rank**
    - Democrat
    - Republican
    - Other

11. How close do you live to campus? **Ordinal**
    On campus
    Near campus
    Far from campus

12. The number of aggressive acts displayed by children during recess. **Cardinal**

13. What is your attitude about adding fluoride to the city’s water supply? **Ordinal**
    - Strongly oppose
    - Somewhat oppose
    - Neutral
    - Somewhat support
    - Strongly support

14. Give each county in Utah a score based upon how much they spend per capita on public schooling (the county spending the most gets a score of ‘1’, second most a score of ‘2’, and so on). **Rank**

15. Order of finish in a golf tournament (1st, 2nd, etc.). **Rank**

16. Have each student in a class take an exam, then give them a score based upon how they did (student with the lowest score gets a ‘1’, second lowest a ‘2’, and so on). **Rank**

17. Which type of car do you most often drive? **Nominal**
    - U.S.
    - Foreign
    - Neither

18. Order of finish in a foot race. **Rank**
19. The miles-per-gallon of a car. **Cardinal**

20. What size vehicle do you prefer to own? **Ordinal**
   - Small (subcompact, compact)
   - Medium (full-size sedan)
   - Large (SUV)

21. The height (in feet) of trees. **Cardinal**

22. How much do you like chocolate? **Ordinal**
   - Don’t like it
   - Like it a little
   - Like it a lot
   - Love it

23. Whether you are really measuring what you claim to be measuring is a question of measurement **validity**.

24. Whether your measuring technique is consistent is a question of measurement **reliability**.

25. If your measurement lacks validity then statistical techniques...
   - can be used to compensate for the lack of validity
   - **cannot compensate for that** (garbage in -> garbage out)

**Sampling**

26. The term **population** refers to the group we are trying to find out about when we run a study.

27. The term **sample** refers to the subset of the population that we actually measure.

28. If a sample is similar to the population in terms of the variable we are studying then it is called a **representative** sample.
29. If a sample is not similar to the population in terms of the variable we are studying then it is called an unrepresentative sample.

30. A sample that is unrepresentative simply due to who happened to be randomly selected from the population is said to have random sampling error.

31. A sample that is unrepresentative for any reason other than chance is called a biased sample.

32. Which of the following are statistical procedures specifically designed to handle?
   - having a biased sample
   - having random sampling error in your sample

33. What happens if you have a biased sample?
   - statistical procedures can be used to compensate
   - statistical procedures will lead to flawed results

34. You can keep bias out of your sample by using random sampling techniques.

35. Which of the following is an attribute of simple random sampling?
   - representative people have a better chance of being selected
   - everyone has an equal chance of being selected

36. Which of the following is an attribute of simple random sampling?
   - each selection is independent of the other selections
   - who you select influences who gets selected next

37. Which type of sampling is used in the social sciences?
   a: sampling without replacement
   b: sampling with replacement
38. Which type of sampling fits the criteria of simple random sampling?
   a: sampling with replacement
   b: sampling without replacement

39. Under what condition is sampling without replacement about the same as sampling with replacement?
   a: when your sample is large compared to the population
   b: when your sample is small compared to the population

40. When can subject attrition introduce bias into a sample (even one that was created using random sampling)?
   a: when the reason for not participating is related to the nature of the experiment
   b: when the reason for not participating is purely random

41. If you randomly sample, which of the following can increase the probability of obtaining a representative sample? (multiple select)
   a. use a large sample
   b. use a small sample
   c. use a variable that has a large amount of variability among its scores
   d. use a variable that has a small amount of variability among its scores

42. Which type of sampling is most often used in psychology?
   a: random sampling
   b: convenience sampling

43. Is convenience sampling a form of random sampling? (yes/no)

44. Which of the following are acceptable ways for addressing the bias that might occur due to convenience sampling. (multiple select)
   a. don’t worry about it, statistical procedures can compensate
   b. measure something where you would probably have gotten the same results if you had randomly sampled
   c. create a representative sample
   d. be careful to whom you generalize the results
SPSS: Compute Function

The first part of the assignment was rather lengthy so I’ll have this part be rather short. We are going to look at the ability to compute new variables out of old variables using the ‘Compute’ function of SPSS. Start by loading the data3.sav file for Assignment 2, it is the same data as the data.txt file from Assignment 1 but I saved it as an SPSS data file.

We are going to begin by creating a new variable that is the sum of the scores on Test1 and Test 2. Go to the Transform menu and select Compute Variable (remember that I will start to refer to instructions like that as Transform>>ComputeVariable). We will start off by naming our new variable ‘TestSum’, type ‘TestSum’ (without the quotes) into the box labeled ‘Target Variable’. You will be putting the instructions for how to compute the new variable into the ‘Numeric Expression’ box. There are several ways we can tell SPSS to sum two variables, I recommend you play around with each way as each has its advantages (particularly in the future when we need to use this Compute function to actually do useful things):

1. In the Numeric Expression box type ‘Test1 + Test 2’ (without the quote marks). Click the OK button. Or,

2. In the box that lists the variables, click on Test1 then click the arrow pointing to the Numeric Expression box and that will move the variable name into the box. Then type ‘+’ after ‘Test1’, then click on Test2 in the variable box and click on the arrow to move it into the Numeric Expression box. Click the OK button. The advantage of using this approach over the one above is that you don’t have to worry about making a typo when inputting the names of the variables. Or,

3. Go to the ‘Function group’ box and click on ‘All’. Then in the ‘Functions and Special Variables’ box scroll down until you find ‘Sum’. Click on that and a description of what the function ‘Sum’ does will appear in the box to the left. Click on the up arrow to insert the Sum function into the Numeric Expression box. You will note that there are two question marks in the sum function, you need to replace those question marks with the names of the two variables (separated by a comma), which you can accomplish by typing their names or clicking on the names and moving them into the function (similar to what you did in the second option above). Click the OK button. This reads more complicated then it is, after doing it you’ll see it’s quite simple. The advantage of this approach will become apparent when we get to more complicated computations we might want to do.
Once you have completed one of the steps above look back at the data window to make sure it worked, then sort the data by variable TestSum (sorting was covered in the previous assignment). Here are a few questions to make sure you did this part successfully:

45. The lowest test sum equaled **184.00**.

46. The subject ID number that had a test sum of 193 was __ 30 ______.

47. The highest test sum equaled __214.00_____.

I’d like you to do one more little wrinkle before we quit. Let’s create a variable that contains the square roots of all of the sums. Call it ‘SqRoots’. In the ‘Function group’ box click on either ‘All’ or ‘Arithmetic’ (the square root function is in the ‘Arithmetic’ group, but all functions are in the ‘All’ group). Then in the ‘Functions and Special Variables’ box scroll through the list until you find a function name that might stand for ‘square root’, click on that, and look at its description in the box to the left to make sure it is indeed square root. Then, click on the up arrow to move that function into the Numeric Expression box, and insert TestSum as the variable (replacing the ‘?’ in the function). Click OK.

Another way you could have done this, by the way, is by typing ‘TestSum ** 0.5’ into the Numeric Expression box. SPSS uses ‘**’ to stand for ‘raise to the power of’ (e.g. 3**2 gives you the square of 3) and when you raise a number to the power of 0.5 you get the square root of the number. There is no special reason to be interested in the square roots of the test sums, I just want you to learn a little more about computing new variables.

Look at the data window to make sure your variable SqRoots does indeed contain the square roots of all of the test sums. Then answer the following question:

48. The square root of the test sum for subject ID 5 was ____13.67_____. (Remember to not round off more than allowed in the general course rules for rounding).

That’s it for this one.