

**VARIABILITY HOMEWORK**

**How to get online answers for the questions that require calculations.** *In all the practice homeworks, answers to problems that require calculations (#1 and #3 in this assignment) are available by using StatTool. The Psych 3000 Tutorial describes how to use StatTool in some detail. You can get to StatTool from your Online Desk, or from some other screen such as Ducks in a Row. Brief instructions are included below.*

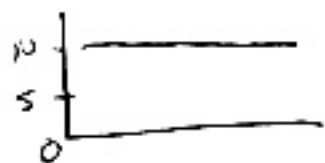
1. Open StatTool. [The page that opens has instructions if you scroll down.] Press the “Analyze Data” button. You will see two screens, one white and blank and one pale yellow (raw data window).
2. On the upper left hand corner of the pale yellow screen, you will find a “File” menu. Click on the word “File.” A menu will drop down. The first choice on the menu is “Open from File.” Click on “Open from File.”
3. A small “menu window” will pop up. Read the menu. Click on the filename appropriate to the homework and problem number you are working on. For example, for Problem 2 of the Variability homework, click on “HW\_Variability\_2.dat”.
4. The data (the numbers you see below in problem 2) will appear in the pale yellow window. Now you can “analyze” the numbers, that is, you can have the computer do the calculations.
5. In the upper left hand corner of the pale yellow (raw data) window there is a menu named “Des Stats.” This stands for descriptive statistics. Click on it. It gives you two choices. Click on “Variability,” then click on the “Variance.” Also click on “Standard Deviation.” You can also get the mean just as you did on the previous homework for central tendency.
6. Instantly the results of that analysis appear in the small white (statistical results) window. You will see a variance and a standard deviation for each of the data sets in problem 2 below.

**It is important to learn to use StatTool.**

1. What is the nature of the distribution if variance is 0?
2. For each of the distributions of numbers given below draw a number line from 0 to about 25. Put a dot for each score on the number line. If a score occurs more than once pile the dots upward on top of each other so you can see each one. Visually get a sense of how spread out or variable each of these distributions is. Then calculate the mean, the variance, and the standard deviation of each of the distributions.
  - a) 10, 8, 6, 4, 1, 9, 2, 2, 8, 0
  - b) 1, 3, 3, 5, 5, 5, 7, 7, 9
  - c) 20, 1, 2, 5, 4, 4, 4, 0
  - d) 5, 5, 5, 5, 5, 5, 5, 5, 5, 5

# Variability Homework

- 1) The distribution would be a straight flat line because every score would be exactly the same.



$$2) (a) \quad M = \frac{\sum X}{N} = \frac{50}{10} = 5$$

$$S^2 = \frac{\sum (x_i - M)^2}{N} = \frac{120}{10} = 12 \quad S = \sqrt{S^2} = \sqrt{12} = 3.464$$

$x_i$	$x_i - M$	$(x_i - M)^2$
10	5	25
8	3	9
6	1	1
4	-1	1
1	-4	16
9	4	16
2	-3	9
2	-3	9
8	3	9
0	-5	25
		<hr/>
		$\sum 120$

(2b)

$$M = \frac{45}{9} = 5$$

$$S^2 = \frac{48}{9} = 5.3$$

$$S = \sqrt{5.3} = 2.302$$

$X_i$	$X_i - M$	$(X_i - M)^2$
1	-4	16
3	-2	4
3	-2	4
5	0	0
5	0	0
5	0	0
7	2	4
7	2	4
9	4	16
		<hr/>
		$\leq 48$

(2c)

$$M = \frac{40}{8} = 5$$

$$S^2 = \frac{278}{8} = 34.75$$

$$S = \sqrt{34.75} = 5.895$$

$X_i$	$X_i - M$	$(X_i - M)^2$
20	15	225
1	-4	16
2	-3	9
5	0	0
4	-1	1
4	-1	1
4	-1	1
0	-5	25
		<hr/>
		$\leq 278$

(2d)

$$M = 5$$

$$S^2 = \frac{0}{10} = 0$$

$$S = \sqrt{0} = 0$$

$X_i$	$X_i - M$	$(X_i - M)^2$
5	0	0
5	0	0
5	0	0
5	0	0
5	0	0
5	0	0
5	0	0
5	0	0
5	0	0
5	0	0
		<hr/>
		$\leq 0$

3) The standard deviation is so large because of the presence of one score that is very large in comparison to the others. This kind of score is sometimes called an outlier. The presence of this extreme score inflates the standard deviation.

4a) The scientific hypothesis is that <sup>use of</sup> marijuana reduces short-term memory.

b) Abstractly the IV is ~~presence~~ use of (or no use) of marijuana. The DV is short-term memory.

c) The operational definition of the IV is the injection of .9mg/Kg dose of THC or saline.

The operational definition of the DV is the difference score on the Digit Symbol Substitution Test.

d) The mean difference for placebo group  
 $\frac{8}{9} = .889$

d) Mean difference  $THC = \frac{-46}{9} = -5.111$

e) Placebo

Range =  $10 - (-3) = 13$

AD =  $\frac{\sum |x_i - M|}{N} = \frac{30.889}{9} = 3.432$

$M = .889$

Variance =  $S^2 = \frac{150.8889}{9} = 16.765$

Standard Deviation  $S = \sqrt{S^2} = \sqrt{16.765} = 4.095$

Placebo	$x_i$	$x_i - M$	$ x_i - M $	$(x_i - M)^2$
	-3	-3.889	3.889	15.124
	10	9.111	9.111	83.010
	-3	-3.889	3.889	15.124
	3	2.111	2.111	4.456
	4	3.111	3.111	9.678
	-3	-3.889	3.889	15.124
	2	1.111	1.111	1.234
	-1	-1.889	1.889	3.568
	-1	-1.889	1.889	3.568
			$\Sigma 30.889$	$\Sigma 150.889$

THC Group

$$\text{Range} = (-17) - (5) = 22$$

$$AD = \frac{|x_i - M|}{N} = \frac{40.889}{9} = 4.543$$

$$M = -5.111$$

$$\text{Variance} = S^2 = \frac{312.889}{9} = 34.765$$

$$\text{Standard Deviation} = S = \sqrt{34.765} = 5.896$$

THC	$x_i$	$x_i - M$	$ x_i - M $	$(x_i - M)^2$
	5	10.111	10.111	102.232
	-17	-11.889	11.889	141.348
	-7	-1.889	1.889	3.568
	-3	2.111	2.111	4.456
	-7	-1.889	1.889	3.568
	-9	-3.889	3.889	15.124
	-6	-0.889	0.889	0.790
	1	6.111	6.111	37.344
	-3	2.111	2.111	4.456
			$\Sigma 40.889$	$\Sigma 312.889$

⑧

The data pattern supports the scientific hypothesis, People's memory was worse after administration of THC. Their mean short-term memory difference was -5.111 which shows their short-term memory was better before THC. The control group short-term memory score showed little difference. ⑤

3. Why is the standard deviation in part “c” of question 2 so large? Describe the effect of one extreme deviation on the standard deviation.

4. A researcher hypothesizes that short term memory is reduced while under the influence of marijuana. She tests 18 naive subjects on the Digit Symbol Substitution Test to establish a baseline for their short term memory. She then randomly divides the 18 subjects into two groups of nine each. One group is a placebo group; one group is a THC group. She injects the THC group with a .9 mg/kg dose of THC (the active ingredient in marijuana). She injects the Placebo group with an isotonic saline solution (a salt solution that is similar to body fluids). Fifteen minutes after these injections she re-administers the Digit Symbol Substitution Test, yielding a second score for each subject. The baseline scores were subtracted from the second scores. The resulting difference scores are shown below. A negative difference score means that the second score was lower than the baseline score.

Subject	1	2	3	4	5	6	7	8	9
Placebo	-3	10	-3	3	4	-3	2	-1	-1
THC	5	-17	-7	-3	-7	-9	-6	1	-3

- What is the scientific hypothesis?
- Abstractly, what are the independent (IV) and dependent (DV) variables?
- What are the operational definitions of the IV and DV?
- Find the mean of the difference scores for both the placebo and the THC groups.
- Find the range, average deviation, variance, and standard deviation of each of the Placebo and THC groups.
- Does the pattern of results support the scientific hypothesis? Show, explicitly, why or why not.

5. This is a variance contest. You may choose 5 intergers (the counting numbers) between 1 and 10 for each case below. You **may repeat** a number as many times as you wish.

- Choose 5 numbers that give you as low a variance as possible.
- Choose 5 numbers that give you as large a variance as possible.

How would a) and b) change if you **can not repeat** any numbers when you choose 5 numbers between 1 and 10?

- Choose 5 numbers that give you as low a variance as possible.
- Choose 5 numbers that give you as large a variance as possible.

