Assignment 4: One-Sample t Test

Use the following data to determine if the mean Verbal SAT score of Midwest states is different from the national average, $\mu = 500$, $\sigma = 100$.

Midwest State	Verbal SAT Score
North Dakota	515
South Dakota	514
Nebraska	514
Kansas	503
Minnesota	511
Iowa	516
Missouri	515
Wisconsin	510
Illinois	497
Indiana	492
Ohio	495
Michigan	501

SPSS Instructions

- On the bottom left, click Variable View.
- Enter 'State' in the first cell.
- Enter 'VerbalSAT' in the cell below it.
- In the first cell under 'Type' select 'String' and click OK.
- On the bottom left, click Data View.
- Enter the state names and verbal SAT scores.
- Click Analyze, Compare Means, One-Sample T Test.
- Move VerbalSAT into the Variables box on the right.
- Enter '500' in the 'Test Value' box and click OK.
- Click Analyze, Compare Means, One-Sample T Test.
- Enter '0' in the 'Test Value' box and click OK.
- Save the Data file and Output file separately. Use informative file names.

SPSS Data

	State	VerbalSAT
1	ND	515.00
2	SD	514.00
3	NE	514.00
4	KS	503.00
5	MN	511.00
6	IA	516.00
7	MO	515.00
8	WI	510.00
9	IL	497.00
10	IN	492.00
11	OH	495.00
12	MI	501.00

SPSS Output

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
VerbalSAT	12	506.9167	8.80556	2.54195

One-Sample Test

Test Value = 500

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
VerbalSAT	2.721	11	.020	6.91667	1.3219	12.5115

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
VerbalSAT	12	506.9167	8.80556	2.54195

One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
VerbalSAT	199.421	11	.000	506.91667	501.3219	512.5115

Written Answers

Show all work.

(1) Provide the notation for the null and research hypotheses, and a written statement for the former.
(2) Calculate t by hand, provide the result in APA format, and write a conclusion. Use α .05. You don't have to calculate the mean and standard deviation; you may take them from the SPSS Output.
(3) Provide the effect size using Cohen's d and write a conclusion.
(4) Suppose we don't know μ. Calculate the Confidence Interval using α .05 and write a conclusion.

1.)
H_0: $\mu = 500$
H_1: $\mu \neq 500$

Null hypothesis: There is no statistically significant difference in the mean Verbal SAT scores between Midwest states and the nation.

2.) $t = \frac{\bar{x} - u}{s/\sqrt{N}}$ $t = \frac{506.917 - 500}{8.806/\sqrt{12}}$ $t = \frac{6.917}{2.542}$ $\boxed{t = 2.72}$

$df = N - 1 = 11$

The critical values for 11 df using $\alpha .05 = \pm 2.20$. The test statistic of $2.72 > 2.20$, so we reject H0.

Result in APA format: $t(11) = 2.72$, $p = .02 < .05$

Conclusion: The population mean of Midwest states' Verbal SAT scores is a statistically significant higher value than that of the nation.

3.) $\hat{d} = \frac{\bar{x} - \mu}{s}$ $\hat{d} = \frac{506.917 - 500}{8.806}$ $\boxed{\hat{d} = .79}$

Conclusion: Midwest states scored .79 standard deviations above the population mean, indicating a medium effect.

4. $CI_{.95} = \bar{x} \pm t_{df} \times s/\sqrt{N} = 506.917 \pm 2.201 \times 8.806/\sqrt{12}$
$= 506.917 \pm 5.595 = 501.32, 512$

$= 501.32 \leq \mu \leq 512.51 \rightarrow$ $\boxed{95\%\ CI\ [501.32, 512.51]}$

Conclusion: There is a 95% probability that the interval 501.32 to 512.51 includes the population mean of Midwest states Verbal SAT scores.