**\*\* CODE IN THE SAS FILE \*\***

**1) (i) Obtain the sample mean and standard deviation of the sales receipts for the trained**

**and untrained salespersons and briefly interpret your findings. (3 marks)**

🡪 **Interpretation:**

1) Mean Sales (Take1):

This will give the average sales of the trained salespersons for the 40 shops, which is: 1498.70.

2) Mean Sales (Take2):

This will give the mean sales of the untrained salespersons for the 40 stores, which is: 1447.75.

3) Standard Deviation (Take1):

This will give you the measure of spread (dispersion) of the sales for the trained salespersons, that's: 207.36.

4) Standard Deviation (Take2):

This will give you the measurement of spread (dispersion) of the sales of the untrained salespersons, that's: 218.

The mean for the trained salespersons is higher than for the untrained, this indicates that the training was effective.

Furthermore, a smaller standard deviation for one group compared to the other implies more consistent performance.

**1) (ii) It is planned to conduct a statistical test to compare the mean sales receipts of the trained and untrained salespersons.**

**What distributional assumption must be made in order for the parametric statistical test to be valid?**

**Investigate the tenability of this assumption via an appropriate graphical technique (i.e., a data plot or plots). (6 marks)**

🡪 **Interpretation:**

1) The Histogram is roughly a bell-shaped symmetric distribution as the differences are normally distributed.

2) The Q-Q plot (quantile-quantile plot) indicates points close to the diagonal line as the differences are normally distributed.

3) As such plots indicate deviations from normality (e.g., skewness, heavy tails), we will need to employ non-parametric tests.

**1) (iii) Formulate and conduct a suitable parametric test. If appropriate, give an associated estimate and a corresponding 95% confidence interval.**

**Carefully interpret all your findings. (16 marks)**

🡪 Interpretation:

1) t-statistic: The test statistic for the paired t-test is 1.72, indicating a moderate difference between the mean sales of trained and untrained salespersons.

2) p-value: As the p-value is 0.0942, it's greater than 0.05, we fail to reject the null hypothesis (no significant difference).

3)The 95% confidence interval (-9.12 to 111.0) includes zero, suggesting that the true mean difference might be zero.

This further supports that we do not have enough evidence to claim a significant effect of training on sales.

**Conclusion:**

The paired t-test results indicate that training does not have a significant effect on sales, as the observed difference in means is not statistically significant at the 5% level.

**1) (iv) Formulate and conduct the equivalent non-parametric test to that employed in (iii).**

**Critically compare the outcomes of the two tests. (11 marks)**

🡪 Interpretation:

1) Student’s t-test results:

a) Take1: t = 45.71, p < 0.0001 (significant)

b) Take2: t = 42.00, p < 0.0001 (significant)

2) Wilcoxon Signed-Rank Test results: reject H0

a) Take1: S = 410, p < 0.0001 (significant)

b) Take2: S = 410, p < 0.0001 (significant)

3) Sign Test results: reject H0

a) Take1: M = 20, p < 0.0001 (significant)

b) Take2: M = 20, p < 0.0001 (significant)

The paired t-test also did not reveal a difference in sales between trained and untrained salesmen (p = 0.0942).

The Wilcoxon signed-rank test and Sign test both revealed a difference (p < 0.0001), which implies that the training impacted sales.

Since the Wilcoxon and Sign tests do not need normality, their results show that the normality assumption of the paired t-test is not met and the parametric test is thus not the most suitable in this case.

**Conclusion:**

The Wilcoxon signed-rank test is conclusive evidence that training has a statistically significant impact on sales, opposite to the findings of the paired t-test.

The difference in results means that the distribution of the data can be non-normal, and this affects the t-test validity.

Recommendation: Since non-parametric tests are more robust for non-normal data, we can depend on the conclusion from the Wilcoxon signed-rank test and conclude that training likely had a major effect on sales.

**1) (v) Hence advise the manager regarding the effectiveness of the proposed training course.**

**What else would influence the decision on whether to implement the course for all cosmetic salespersons in future years? (4 marks)**

🡪 **According to the statistical analysis:**

1) Paired t-test Results:

- The test failed to show substantial evidence that training enhances sales (p = 0.0942).

- The 95% confidence interval contains zero, which means that the true difference could be zero.

2) Wilcoxon Signed-Rank Test Results:

- The non-parametric test, which does not assume normality, showed a significant difference (p < 0.0001).

- This suggests that training had a statistically significant positive impact on sales.

**Recommendation on Training Effectiveness:**

Because the Wilcoxon test offers strong proof that training raises sales, continuing to train is a good idea.

The discrepancy between the parametric and non-parametric test outcomes, however, indicates that additional research is required to verify the effect.

**Other Factors Affecting Future Implementation:**

a) Training Cost vs. Revenue Growth:

- The cost of training should be matched against expected improvement in sales.

b) Variation in Employee Performance:

- Some employees might learn more than others; monitoring performance is required.

c) Long-Term Effect:

- The effectiveness of the training must be monitored over a long period.

d) Other Influencing Variables:

- Externalities (seasonal demand, promotions, etc.) can affect sales.

e) Feedback from Salespersons:

- Employees' opinions about the training can be utilized to make the programs better and more precise in the future.

If the increase in sales derived from training is of greater value than expenses and is focused on business objectives,

it is better to offer the course to the cosmetic salespersons in the future. Continuous assessment and optimization are, however, essential.