Assignment 1 – Within VR Performance Conditioned on Cognitive Function

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Question: 01

Range = 24 to 63

Mean (M) = 39.31

Standard Deviation (SD) = 12.32

Median (Md) = 36

APA Format:

Block Design Scores had a mean of M = 39.31 & a standard deviation of SD = 12.32, ranging from 24 to 63. Resulting implications are the distribution is comparatively typical, as indicated by the similarity between the mean (39.31) and median (36). The moderate variety in individuals' cognitive skills is shown by a standard deviation of 12.32. Potential connections between cognitive capacity and VR task efficiency are hinted at by the vast range (24–63). Measures of central tendency (like mean, median, and mode) and measures of dispersion or variation (like range, standard deviation, and variance) are the primary tools used for summary statistics (Kaliyadan & Kulkarni, 2019).

Question: 2

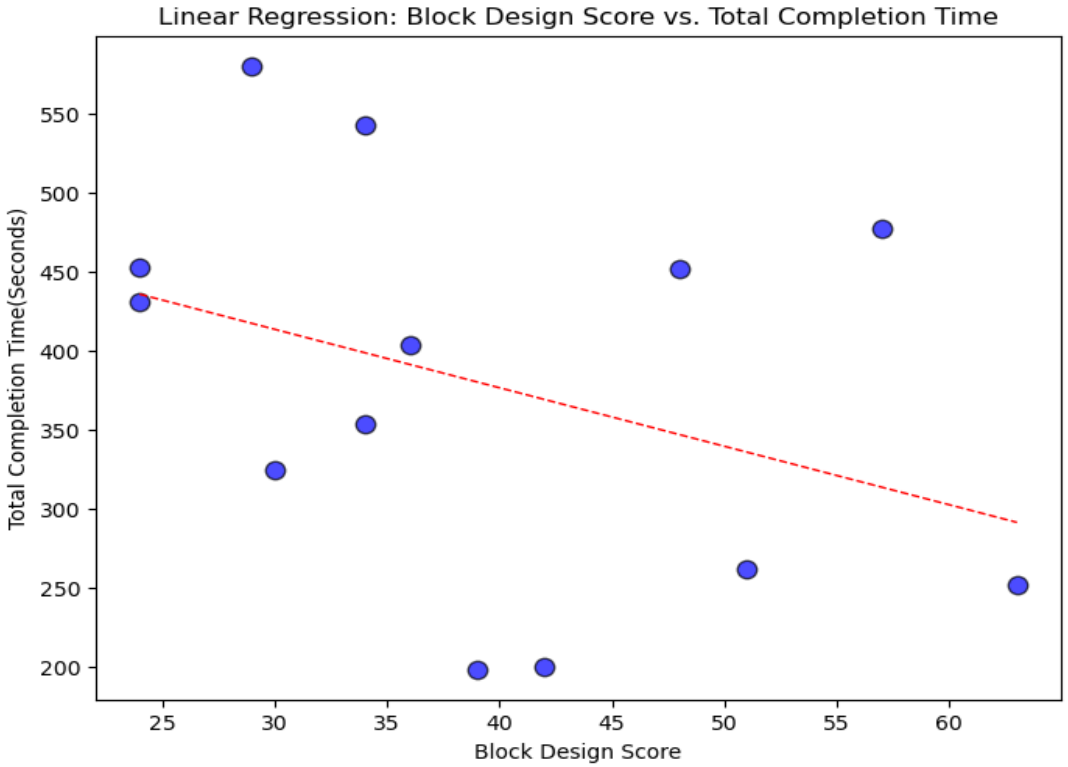
The amount of time needed for each individual to do the VR-based job was reflected in the overall recipe completion time. The completion times, which ranged from 198.27 seconds to 580.02 seconds, varied greatly across participants. The following were the individual completion times: C008: 352.999 seconds, C009: 452.494 seconds, C013: 451.593 seconds, C016: 198.272 seconds, C017: 403.607 seconds, C021: 580.020 seconds, C024: 200.094 seconds, C025: 430.630 seconds, C032: 251.383 seconds, C033: 476.876 seconds, C037: 542.508 seconds, C040: 261.565 seconds, and C071: 324.162 seconds. This large variation in completion times points to fluctuations in participant efficiency, which may be caused by cognitive capacity, past VR experience, motor abilities, or other outside variables.

Question: 3

To investigate the connection among Block Design Scores & Total Recipe Completion Time (i.e., VR task completion time), a Spearman correlation study was performed. The results showed a p-value of 0.18 and a Spearman Correlation Coefficient (r_s) of -0.40. The relationship is not statistically significant ($p > 0.05$), despite a little negative correlation that suggests people with higher cognitive scores tended to finish the VR task faster. Therefore, these results by themselves do not allow us to reject the null hypothesis.

Question: 4

A scatter plot was made in order to visually assess the relationship between Block Design Scores & Total Recipe Completion Time. A point on the plot represents each participant's performance during the VR task. The general decreasing trend suggests that quicker completion of tasks is linked to higher Block Design Scores. Despite the trend, the dispersion of data points suggests that factors other than cognitive function (such as task complexity, motor coordination, or VR experience) may also significantly affect performance.



Question:5

The association between Block Design Scores and Total Completion Time was investigated using a linear regression analysis. The results indicated a negative slope of -3.70, suggesting that higher cognitive performance, as measured by Block Design Scores, tends to be linked with faster task completion. However, the weak correlation ($\rho = -0.3967$) and the low explanatory power of the model indicate that cognitive ability alone does not fully account for variations in task completion time. This suggests that additional factors, such as motor skills, task familiarity, or environmental influences, may contribute to performance differences.

Question:6

The scatter plot's overlapping linear regression line supports the idea that Block Design Scores with Total Completion Time are negatively correlated. The negative slope of the regression line indicates that the Block Design Score tends to decline as job completion time rises.

Question: 7

The overall analyses indicate a modest negative association between VR task performance (as measured by Total Completion Time) and cognitive function (Block Design Scores). This association was not statistically significant ($r = -0.40$, $p = 0.18$), despite the data suggesting that people with greater cognitive abilities typically finish activities faster. These findings imply that cognitive function, while important, does not solely determine VR task efficiency. In addition to cognitive ability, factors such as motor coordination, task complexity, and prior VR experience are likely to contribute substantially to performance variability. This multidimensional perspective underscores the need for future research to employ more comprehensive models that integrate these additional factors, thereby enhancing our ability to predict and optimize VR task performance in practical settings.

Question: 8

To provide a more balanced assessment of performance, the Task Efficiency Score (TES) was introduced. TES integrates both cognitive performance and task speed, offering a metric that reflects the efficiency with which participants utilize their cognitive abilities in a VR setting. Higher TES scores indicate greater efficiency, while lower scores may signal slower or less effective performance.

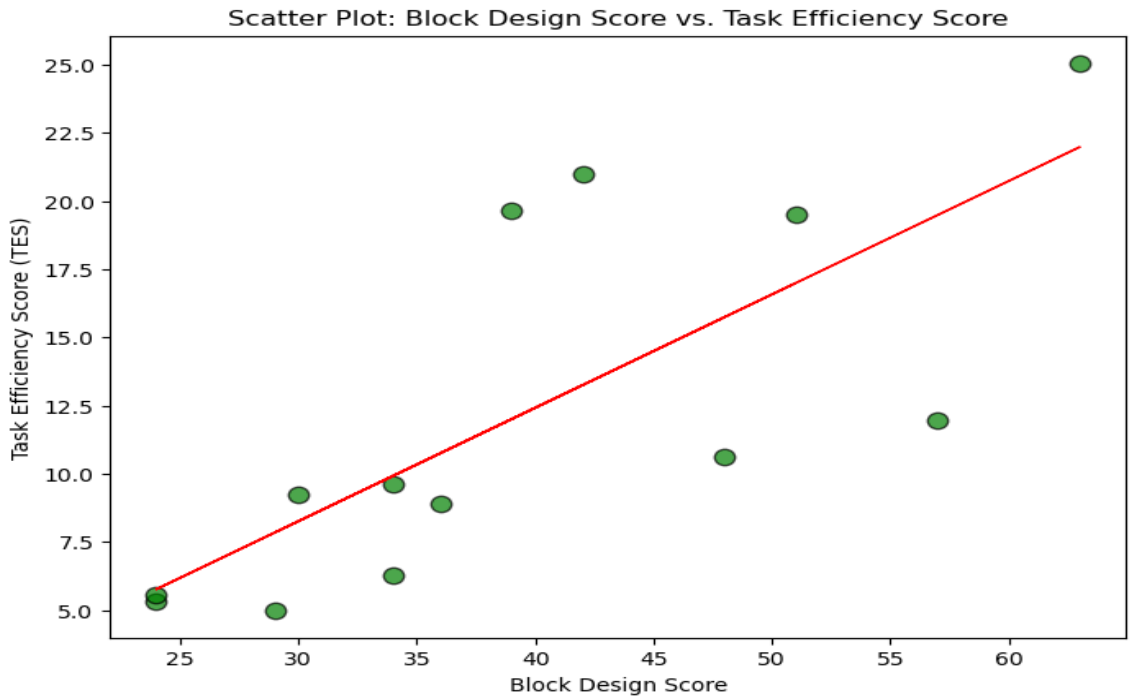
Task Efficiency Scores for some participants:

- **C008:** 9.63
- **C009:** 5.30
- **C013:** 10.63
- **C016:** 19.67
- **C017:** 8.92

Question: 9

A further Spearman correlation analysis was performed to assess the relationship between TES and Block Design Scores. The results were:

- **Spearman Correlation Coefficient (r_s):** 0.8595
- **p-value:** 0.0002



These results indicate a strong and statistically significant positive association between TES and Block Design Scores. This indicates that VR task efficiency is typically higher for people with higher cognitive function. When task speed is taken into account, cognitive function is a major predictor of VR task efficiency, as confirmed by the significant connection ($p < 0.001$).

Question:10

The overall findings from this study have several important implications:

- **Variability in Performance:**

  While the raw task completion time shows a weak negative association with cognitive function, this measure alone does not capture all the factors that contribute to VR performance. Variability in task performance is likely influenced by multiple factors, including motor coordination and previous VR experience.

- **Integrated Measure of Efficiency:**

  The introduction of the Task Efficiency Score (TES) provides a more balanced view by combining cognitive performance and task speed. The strong positive correlation

between TES and Block Design Scores suggests that TES is a more effective measure for assessing how cognitive function translates into VR task efficiency.

- **Practical Significance:**

  These implications underscore the importance of considering integrated performance measures in VR research. Relying solely on task completion time may overlook important nuances, whereas TES offers a more comprehensive understanding of how cognitive abilities impact overall task efficiency in VR environments.

- **Future Directions:**

  Further research should explore additional variables (such as motor skills and task complexity) to fully elucidate the determinants of VR performance. Using integrated measures like TES could enhance the assessment of VR-based training and skill evaluations.

References

Kaliyadan, F., & Kulkarni, V. (2019). Types of variables, descriptive statistics, and sample Size. *Indian Dermatology Online Journal, 10*(1), 82–86. https://doi.org/10.4103/idoj.IDOJ_468_18