THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF HEALTH SCIENCES
DEPARTMENT OF PSYCHOLOGY & COUNSELLING
2023/2024 – SEMESTER II —FINAL EXAMINATION

**BSC (HONS) IN PSYCHOLOGY**
**PLU4303 – INTRODUCTION TO STATISTICS IN PSYCHOLOGY - LEVEL 4**
**FINAL EXAMINATION PAPER**
**DURATION: 03 HOURS**

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DATE: 11TH OCTOBER 2024 TIME: 9.30 AM – 12.30PM

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## SECTION 2: STRUCTURED ESSAY QUESTIONS (60 MARKS)

**Choose 04 out of the 06 questions given below and answer using the provided answer sheets.**

2.1 A psychologist conducts a study on the relationship between sleep duration and cognitive performance. Twenty participants were asked to record their nightly sleep durations (in hours) and their scores on a cognitive performance test. The following data represents their responses:

Sleep Duration (hours): 5.3, 5.7, 6.1, 6.5, 6.9, 7.2, 7.5, 7.9, 8.3, 8.7, 8.9, 9.1, 9.5, 9.7, 10.2, 10.5, 10.9, 11.3, 11.7, 12.1

Cognitive Performance Test Scores: 65, 68, 70, 72, 75, 77, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106

i Calculate the mean and median for the cognitive performance test scores. **(2 Marks)**

ii Compute the first quartile (Q1), third quartile (Q3), and the interquartile range (IQR) for the cognitive performance test scores. **(3 Marks)**

iii Using the provided data on cognitive performance test scores, create a box plot for sleep duration. **(5 Marks)**

iv Determine if there are any outliers in the data using the 1.5 IQR rule. **(2 Marks)**

v Using the provided data on sleep duration and cognitive performance test scores, create a scatter plot illustrating the relationship between sleep duration and cognitive performance. Discuss any trends or patterns you observe in the data visualization. **(3 Marks)**

2.2 A psychologist conducted a study to explore stress factors among college students. The study involved collecting data from a sample of 100 college students. The variables investigated were:

a. Stress level (measured on a Likert scale from 1 to 5)
b. Age
c. Gender
d. Year in college (recorded as: freshman, sophomore, junior, senior)
e. Hours of sleep per night
f. Number of courses taken in the current semester
g. Number of extracurricular activities participated in
h. Use of relaxation techniques (recorded as: yes, no)

i Identify the scale of measurement (nominal, ordinal, interval, or ratio) for each of the study variables. **(4 Marks)**

ii Define these variables as Quantitative and Qualitative. **(4 Marks)**

iii Give 2 examples for discrete variables. **(2 Marks)**

iv Explain the concepts of control variable using a relevant example. **(5 Marks)**

2.3 Considering the basic concepts in hypothesis testing and parametric tests, write the answers for the following questions.

i Define the term 'Hypothesis Testing'. **(3 Marks)**

ii Write the steps in Hypothesis testing. **(4 Marks)**

iii Briefly explain the 2 types of Decision errors happen in hypothesis testing. **(2 Marks)**

iv Identify the parametric test for each research problem. (Hint: One sample t-test, One sample -test, Two sample independent t-test, Two sample independent z-test, Paired sample t-test, and ANOVA) **(6 Marks)**

| Research problem | Appropriate parametric test |
|---|---|
| In a study on stress reduction, 20 participants completed a 4-week mindfulness meditation program. Before and after the program, their stress levels were measured using a standardized scale. | |
| A psychologist conducts a study to investigate the effect of different types of exercise on mood improvement. Participants are randomly assigned to one of three groups: Group A performs aerobic exercise; Group B performs strength training, and Group C practices yoga. After four weeks of regular exercise, participants' mood levels are measured using a standardized mood scale. | |
| A production manager of a food producing company wants to test whether the box of cereal contain 368 g of cereal. A random sample of 50 boxes was taken from the daily production and measured the content of each box. The sample mean of the cereal box found to be 372.5 g. | |

2.4 A study was conducted to investigate the relationship between stress levels and sleep quality in a population of 150 individuals. The participants were categorized based on their reported stress levels as either "high stress" or "low stress," and their sleep quality was recorded as either "poor" or "good." The data collected is summarized in the contingency table below:

| Stress Level | Sleep Quality | |
|---|---|---|
| | Poor | Good |
| High Stress | 45 | 30 |
| Low Stress | 25 | 50 |

i Explain the concept of 'chi-squared test' in statistical analysis. **(2 marks)**

ii State the null hypothesis and alternative hypothesis relevant to the above study. **(3 marks)**

iii Determine the values for the letters A-H given in the above table. **(6 marks)**

| Observed Value ($f_0$) | Expected Value ($f_e$) | $\frac{(f_0 - f_e)^2}{f_e}$ |
|---|---|---|
| 45 | A | E |
| 30 | B | F |
| 25 | C | G |
| 50 | D | H |

iv Calculate the chi-squared test statistic. **(2 marks)**

v Compute the test statistics with critical value at 5% significance level and interpret the results. **(2 marks)**

2.5 A researcher aims to explore the relationship between the number of hours spent on mindfulness meditation per week and the resulting reduction in stress levels among 5 participants. The data collected includes the number of hours each participant meditated weekly and their corresponding reduction in stress scores after six weeks. The data is presented below:

| Participant | Hours of Meditation per Week (X) | Stress Reduction (Points) (Y) |
|---|---|---|
| 1 | 5 | 15 |
| 2 | 7 | 22 |
| 3 | 4 | 10 |
| 4 | 6 | 18 |
| 5 | 8 | 25 |

i Explain the concept of 'Correlation Analysis'. **(3 marks)**

ii Briefly describe what is Spurious Correlation? **(3 marks)**

iii Calculate the Pearson Correlation Coefficient. **(5 marks)**

iv Discuss whether there is a significant relationship between the hours of meditation and stress reduction. **(4 marks)**

2.6 A researcher is investigating the impact of hours of sleep on memory recall performance. The following data was collected from 10 participants, recording the number of hours they slept the night before and their corresponding memory recall scores in a cognitive test. The data is provided below:

| Participant | Hours of Sleep (X) | Memory Recall Score (Y) |
|---|---|---|
| 1 | 2 | 50 |
| 2 | 4 | 55 |
| 3 | 6 | 60 |
| 4 | 8 | 65 |
| 5 | 10 | 70 |
| 6 | 12 | 75 |
| 7 | 14 | 80 |
| 8 | 16 | 85 |
| 9 | 18 | 90 |
| 10 | 20 | 95 |

i Describe what is Regression Analysis? **(3 marks)**

ii Describe the process of finding the accuracy of a fitted model. **(2 marks)**

iii Estimate the Regression Equation. **(9 marks)**

iv Using the regression equation, predict the Memory Recall score for a patient who sleeps for 15 hours. **(2 marks)**

----------END OF QUESTION PAPER----------

## List of Equations

$$t = \frac{\overline{x_1} - \overline{x_2}}{SD_d/\sqrt{n}}$$

$$SD_d = \sqrt{\frac{\sigma D^2}{n-1} - \bar{x}_d^{\,2}}, \quad \bar{x}_d = \overline{x1} - \overline{x2}$$

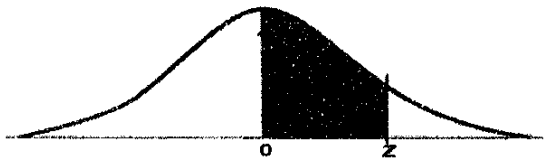
$$r = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 (y_i - \bar{y})^2}}$$

$$\beta_1 = \frac{\sum_{i=1}^{m}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{m}(x_i - \bar{x})^2}$$

$$\beta_0 = \bar{y} - \beta_1 \bar{x}$$

## Chi-square Distribution Table

| d.f. | .995 | .99 | .975 | .95 | .9 | .1 | .05 | .025 | .01 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 2.71 | 3.84 | 5.02 | 6.63 |
| 2 | 0.01 | 0.02 | 0.05 | 0.10 | 0.21 | 4.61 | 5.99 | 7.38 | 9.21 |
| 3 | 0.07 | 0.11 | 0.22 | 0.35 | 0.58 | 6.25 | 7.81 | 9.35 | 11.34 |
| 4 | 0.21 | 0.30 | 0.48 | 0.71 | 1.06 | 7.78 | 9.49 | 11.14 | 13.28 |
| 5 | 0.41 | 0.55 | 0.83 | 1.15 | 1.61 | 9.24 | 11.07 | 12.83 | 15.09 |
| 6 | 0.68 | 0.87 | 1.24 | 1.64 | 2.20 | 10.64 | 12.59 | 14.45 | 16.81 |
| 7 | 0.99 | 1.24 | 1.69 | 2.17 | 2.83 | 12.02 | 14.07 | 16.01 | 18.48 |
| 8 | 1.34 | 1.65 | 2.18 | 2.73 | 3.49 | 13.36 | 15.51 | 17.53 | 20.09 |
| 9 | 1.73 | 2.09 | 2.70 | 3.33 | 4.17 | 14.68 | 16.92 | 19.02 | 21.67 |
| 10 | 2.16 | 2.56 | 3.25 | 3.94 | 4.87 | 15.99 | 18.31 | 20.48 | 23.21 |
| 11 | 2.60 | 3.05 | 3.82 | 4.57 | 5.58 | 17.28 | 19.68 | 21.92 | 24.72 |
| 12 | 3.07 | 3.57 | 4.40 | 5.23 | 6.30 | 18.55 | 21.03 | 23.34 | 26.22 |



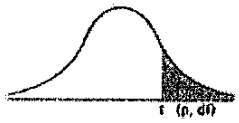

This table presents the area between the mean and the Z score . When Z=1.96, the shaded area is 0.4750.

**Areas Under the Standard Normal Curve**

| Z | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.0000 | 0.0040 | 0.0080 | 0.0120 | 0.0160 | 0.0199 | 0.0239 | 0.0279 | 0.0319 | 0.0359 |
| 0.1 | .0398 | .0438 | .0478 | .0517 | .0557 | .0596 | .0636 | .0675 | .0714 | .0753 |
| 0.2 | .0793 | .0832 | .0871 | .0910 | .0948 | .0987 | .1026 | .1064 | .1103 | .1141 |
| 0.3 | .1179 | .1217 | .1255 | .1293 | .1331 | .1368 | .1406 | .1443 | .1480 | .1517 |
| 0.4 | .1554 | .1591 | .1628 | .1664 | .1700 | .1736 | .1772 | .1808 | .1844 | .1879 |
| 0.5 | .1915 | .1950 | .1985 | .2019 | .2054 | .2088 | .2123 | .2157 | .2190 | .2224 |
| 0.6 | .2257 | .2291 | .2324 | .2357 | .2389 | .2422 | .2454 | .2486 | .2517 | .2549 |
| 0.7 | .2580 | .2611 | .2642 | .2673 | .2704 | .2734 | .2764 | .2794 | .2823 | .2852 |
| 0.8 | .2881 | .2910 | .2939 | .2967 | .2995 | .3023 | .3051 | .3078 | .3106 | .3133 |
| 0.9 | .3159 | .3186 | .3212 | .3238 | .3264 | .3289 | .3315 | .3340 | .3365 | .3389 |
| 1.0 | .3413 | .3438 | .3461 | .3485 | .3508 | .3531 | .3554 | .3577 | .3599 | .3621 |
| 1.1 | .3643 | .3665 | .3686 | .3708 | .3729 | .3749 | .3770 | .3790 | .3810 | .3830 |
| 1.2 | .3849 | .3869 | .3888 | .3907 | .3925 | .3944 | .3962 | .3980 | .3997 | .4015 |
| 1.3 | .4032 | .4049 | .4066 | .4082 | .4099 | .4115 | .4131 | .4147 | .4162 | .4177 |
| 1.4 | .4192 | .4207 | .4222 | .4236 | .4251 | .4265 | .4279 | .4292 | .4306 | .4319 |
| 1.5 | .4332 | .4345 | .4357 | .4370 | .4382 | .4394 | .4406 | .4418 | .4429 | .4441 |
| 1.6 | .4452 | .4463 | .4474 | .4484 | .4495 | .4505 | .4515 | .4525 | .4535 | .4545 |
| 1.7 | .4554 | .4564 | .4573 | .4582 | .4591 | .4599 | .4608 | .4616 | .4625 | .4633 |
| 1.8 | .4641 | .4649 | .4656 | .4664 | .4671 | .4678 | .4686 | .4693 | .4699 | .4706 |
| 1.9 | .4713 | .4719 | .4726 | .4732 | .4738 | .4744 | .4750 | .4756 | .4761 | .4767 |
| 2.0 | .4772 | .4778 | .4783 | .4788 | .4793 | .4798 | .4803 | .4808 | .4812 | .4817 |
| 2.1 | .4821 | .4826 | .4830 | .4834 | .4838 | .4842 | .4846 | .4850 | .4854 | .4857 |
| 2.2 | .4861 | .4864 | .4868 | .4871 | .4875 | .4878 | .4881 | .4884 | .4887 | .4890 |
| 2.3 | .4893 | .4896 | .4898 | .4901 | .4904 | .4906 | .4909 | .4911 | .4913 | .4916 |
| 2.4 | .4918 | .4920 | .4922 | .4925 | .4927 | .4929 | .4931 | .4932 | .4934 | .4936 |
| 2.5 | .4938 | .4940 | .4941 | .4943 | .4945 | .4946 | .4948 | .4949 | .4951 | .4952 |
| 2.6 | .4953 | .4955 | .4956 | .4957 | .4959 | .4960 | .4961 | .4962 | .4963 | .4964 |
| 2.7 | .4965 | .4966 | .4967 | .4968 | .4969 | .4970 | .4971 | .4972 | .4973 | .4974 |
| 2.8 | .4974 | .4975 | .4976 | .4977 | .4977 | .4978 | .4979 | .4979 | .4980 | .4981 |
| 2.9 | .4981 | .4982 | .4982 | .4983 | .4984 | .4984 | .4985 | .4985 | .4986 | .4986 |
| 3.0 | .4987 | .4987 | .4987 | .4988 | .4988 | .4989 | .4989 | .4989 | .4990 | .4990 |
| 3.1 | .4990 | .4991 | .4991 | .4991 | .4992 | .4992 | .4992 | .4992 | .4993 | .4993 |
| 3.2 | .4993 | .4993 | .4994 | .4994 | .4994 | .4994 | .4994 | .4995 | .4995 | .4995 |
| 3.3 | .4995 | .4995 | .4995 | .4996 | .4996 | .4996 | .4996 | .4996 | .4996 | .4997 |
| 3.4 | .4997 | .4997 | .4997 | .4997 | .4997 | .4997 | .4997 | .4997 | .4997 | .4998 |
| 3.6 | .4998 | .4998 | .4999 | .4999 | .4999 | .4999 | .4999 | .4999 | .4999 | .4999 |
| 3.9 | .5000 | | | | | | | | | |

Source: Adapted by permission from *Statistical Methods* by George W. Snedecor and William G. Cochran, sixth edit
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Numbers in each row of the table are values on a *t*-distribution with (*df*) degrees of freedom for selected right-tail (greater-than) probabilities (*p*).




| df/p | 0.40 | 0.25 | 0.10 | 0.05 | 0.025 | 0.01 | 0.005 | 0.0005 |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.324920 | 1.000000 | 3.077684 | 6.313752 | 12.70620 | 31.82052 | 63.65674 | 636.6192 |
| 2 | 0.288675 | 0.816497 | 1.885618 | 2.919986 | 4.30265 | 6.96456 | 9.92484 | 31.5991 |
| 3 | 0.276671 | 0.764892 | 1.637744 | 2.353363 | 3.18245 | 4.54070 | 5.84091 | 12.9240 |
| 4 | 0.270722 | 0.740697 | 1.533206 | 2.131847 | 2.77645 | 3.74695 | 4.60409 | 8.6103 |
| 5 | 0.267181 | 0.726687 | 1.475884 | 2.015048 | 2.57058 | 3.36493 | 4.03214 | 6.8688 |
| 6 | 0.264835 | 0.717558 | 1.439756 | 1.943180 | 2.44691 | 3.14267 | 3.70743 | 5.9588 |
| 7 | 0.263167 | 0.711142 | 1.414924 | 1.894579 | 2.36462 | 2.99795 | 3.49948 | 5.4079 |
| 8 | 0.261921 | 0.706387 | 1.396815 | 1.859548 | 2.30600 | 2.89646 | 3.35539 | 5.0413 |
| 9 | 0.260955 | 0.702722 | 1.383029 | 1.833113 | 2.26216 | 2.82144 | 3.24984 | 4.7809 |
| 10 | 0.260185 | 0.699812 | 1.372184 | 1.812461 | 2.22814 | 2.76377 | 3.16927 | 4.5869 |
| 11 | 0.259556 | 0.697445 | 1.363430 | 1.795885 | 2.20099 | 2.71808 | 3.10581 | 4.4370 |
| 12 | 0.259033 | 0.695483 | 1.356217 | 1.782288 | 2.17881 | 2.68100 | 3.05454 | 43178 |
| 13 | 0.258591 | 0.693829 | 1.350171 | 1.770933 | 2.16037 | 2.65031 | 3.01228 | 4.2208 |
| 14 | 0.258213 | 0.692417 | 1.345030 | 1.761310 | 2.14479 | 2.62449 | 2.97684 | 4.1405 |
| 15 | 0.257885 | 0.691197 | 1.340606 | 1.753050 | 2.13145 | 2.60248 | 2.94671 | 4.0728 |
| 16 | 0.257599 | 0.690132 | 1.336757 | 1.745884 | 2.11991 | 2.58349 | 2.92078 | 4.0150 |
| 17 | 0.257347 | 0.689195 | 1.333379 | 1.739607 | 2.10982 | 2.56693 | 2.89823 | 3.9651 |
| 18 | 0.257123 | 0.688364 | 1.330391 | 1.734064 | 2.10092 | 2.55238 | 2.87844 | 3.9216 |
| 19 | 0.256923 | 0.687621 | 1.327728 | 1.729133 | 2.09302 | 2.53948 | 2.86093 | 3.8834 |
| 20 | 0.256743 | 0.686954 | 1.325341 | 1.724718 | 2.08596 | 2.52798 | 2.84534 | 3.8495 |
| 21 | 0.256580 | 0.686352 | 1.323188 | 1.720743 | 2.07961 | 2.51765 | 2.83136 | 3.8193 |
| 22 | 0.256432 | 0.685805 | 1.321237 | 1.717144 | 2.07387 | 2.50832 | 2.81876 | 3.7921 |
| 23 | 0.256297 | 0.685306 | 1.319460 | 1.713872 | 2.06866 | 2.49987 | 2.80734 | 3.7676 |
| 24 | 0.256173 | 0.684850 | 1.317836 | 1.710882 | 2.06390 | 2.49216 | 2.79694 | 3.7454 |
| 25 | 0.256060 | 0.684430 | 1.316345 | 1.708141 | 2.05954 | 2.48511 | 2.78744 | 3.7251 |
| 26 | 0.255955 | 0.684043 | 1.314972 | 1.705618 | 2.05553 | 2.47863 | 2.77871 | 3.7066 |
| 27 | 0.255858 | 0.683685 | 1.313703 | 1.703288 | 2.05183 | 2.47266 | 2.77068 | 3.6896 |
| 28 | 0.255768 | 0.683353 | 1.312527 | 1.701131 | 2.04841 | 2.46714 | 2.76326 | 3.6739 |
| 29 | 0.255684 | 0.683044 | 1.311434 | 1.699127 | 2.04523 | 2.46202 | 2.75639 | 3.6594 |
| 30 | 0.255605 | 0.682756 | 1.310415 | 1.697261 | 2.04227 | 2.45726 | 2.75000 | 3.6460 |
| *z* | 0.253347 | 0.674490 | 1.281552 | 1.644854 | 1.95996 | 2.32635 | 2.57583 | 3.2905 |
| CI | ———— | ———— | 80% | 90% | 95% | 98% | 99% | 99.9% |