**UNIVERSITY OF ESSEX**

1st Year Examinations: Summer 2021

**PS115-4-FY: STATISTICS FOR PSYCHOLOGISTS**

**Time allowed: 24 hours**

Please see your exam timetable or check on FASER for the deadline to upload your answer.

***The times shown on your timetable are in British Summer Time (BST). Please check online for a conversion to your local time if you will be undertaking your assessment outside the United Kingdom***

**Tables and formulae are provided in a separate document. Please download this from Faser.**

For determining ***statistical significance*** you should use a significance level of .05.   
Unless otherwise stated, your **final answers** should be *correct to three significant figures.*   
Whenever you are asked to give the name of a test or procedure, please give the **full name** (e.g., “independent samples *t*-test” rather than “*t*-test”).

**Candidates should answer ALL questions.**

**You must show your workings and the stages you have gone through for all calculations, where indicated, to get full marks. Space is available on the answer sheet for this. Where a question asks you to choose between different options, you may highlight or put an “X” next to your chosen answer.**

The marks available for each question are shown in square brackets.

**About this exam**

* **You have 24 hours to complete this exam** and you can submit at any time during the 24 hours. This extended time period gives you the flexibility to work on your exam at a time that suits you.
* **You are not expected to spend all this time on the exam**.
* **The time allocated for this assessment includes time for you to download this question and answer paper and to upload your question and answers paper to FASER.**
* **You must submit by the deadline**. Please give yourself ample time before the deadline to submit your exam to avoid any potential problems.
* **Please allow at least 30 minutes within your exam time to upload your work**. Once you have completed the assessment do not leave it to the last minute to upload.
* **Please save your work throughout the examination to avoid losing your work**.
* **Please do not communicate with any other candidate in any way during this assessment**. Your response must be your own work. Procedures are in place to detect plagiarism and collusion.

**If you need help**

|  |  |
| --- | --- |
| **Student contacts for all queries, including technical ones** | |
| Live Chat (preferred) | * Within FASER, Moodle, QMP and [www.exams.chat](http://www.exams.chat) * For technical help, for example trouble downloading or submitting the exam, choose **FASER exam support**. * For questions about the exam choose **Exams Office**. |
| Telephone | +44 (0)1206 873926 |
| Email | * Paper queries: Tom Foulsham or Miroslav Sirota, [foulsham@essex.ac.uk](mailto:foulsham@essex.ac.uk) , [msirota@essex.ac.uk](mailto:msirota@essex.ac.uk) * General queries: [exams@essex.ac.uk](mailto:exams@essex.ac.uk) * IT/technical queries: use phone or live chat |

**There are 50 marks available. The marks available for each question are shown in brackets at the end of the question.**

**Question 1**

The table below shows the frequency distribution of responses by a sample of participants to a single attitude item on a questionnaire.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Response** | **Frequency** |  |
|  | **–2** | **2** |  |
|  | **–1** | **2** |  |
|  | **0** | **6** |  |
|  | **+1** | **5** |  |
|  | **+2** | **5** |  |

**(a)** According to the table, how many participants provided a response?

**Answer (a) \_\_\_\_\_\_\_\_**

**(b)** What was the modal response?

**Answer (b) \_\_\_\_\_\_\_\_**

**(c)** What was the range?

**Answer (c) \_\_\_\_\_\_\_\_**

**(d)** What was the median response? **SHOW YOUR WORKING in the box provided.**

**Answer (d) \_\_\_\_\_\_\_\_**

**(e)** What was the mean response? **SHOW YOUR WORKING in the box provided.** Give your answer correct to 2 decimal places (2 d.p.)

**Answer (e) \_\_\_\_\_\_\_\_**

**(f)** What was the interquartile range? **SHOW YOUR WORKING in the box provided.**

**Answer (f) \_\_\_\_\_\_\_\_**

**[6 marks]**

**Question 2**

A reaction time experiment was conducted. Each participant completed 144 trials. Table q2 below shows some reaction times in milliseconds (ms) for a single participant. The reaction times have been put in order from the shortest reaction time to the longest reaction time: only the shortest seven times and the longest seven times are shown.

**The median for these 144 reaction times is 576 ms.**

**The mean for these 144 reaction times is 623 ms.**

**The standard deviation of these 144 reaction times is 148 ms.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Table q2*** | |  | **(a)** | The experimenter plans to use the participant’s average reaction time when the data are analysed further. However, she has been advised that first she should remove any reaction times that are more than 2.5 standard deviations above the mean.  **(i)** How many of the values shown in Table q2 would need to be removed if the psychologist followed this advice? **Show your working below.** {**Hint:** You **cannot** use tables for the normal distribution to answer this question.}  **Number of values to be removed = \_\_\_\_\_\_\_\_\_\_**  **(ii) Based on Table q2, list those values that would be removed in the space below:** |
| Trial number | Reaction time (ms) |
| 121 | 340 |
| 46 | 353 |
| 13 | 378 |
| 45 | 423 |
| 32 | 431 |
| 54 | 444 |
| 50 | 445 |
| … | … |
|  |  |
| … | … |
| 12 | 971 |
| 136 | 973 |
| 41 | 999 |
| 122 | 1015 |
| 144 | 1105 |
| 40 | 1155 |
| 88 | 1181 |
|  |  |

**(b)** You have been shown only some of the values for this participant. Nonetheless, from the scores and summary statistics it is possible to infer the following about the 144 reaction times for this participant.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **(i)** | The scores have… | | *(****Place an X under ONE correct answer****)* | |
|  | a positively skewed distribution. | a negatively skewed distribution. | | an approximately normal distribution. |
|  |  |  | |  |

|  |  |  |
| --- | --- | --- |
| **(ii)** | My answer in (i) is true because | *(****Place an X next to ALL the answers that apply****)* |

|  |  |
| --- | --- |
| *Statement* | *Select all that apply* |
| a) high scores are more spread out than low scores |  |
| b) low scores are more spread out than high scores |  |
| c) the median is higher than the mean |  |
| d) the mean is higher than the median |  |
| e) the median and the mean are the same |  |

**[4 marks]**

**Question 3**

A psychologist is interested in identifying children who are eligible to participate in a “gifted and talented” programme. A large number of children take a screening test. Scores on this test are known to be normally distributed, with a mean of 220 and a standard deviation of 60. Higher scores represent better performance.

What is the cut-off score on this test that separates the best performing 1% of children from the other 99%? **SHOW YOUR WORKING in the box provided**, and give your final answer correct to 1 decimal place (1 d.p.).

**Answer: \_\_\_\_\_\_\_\_\_\_ (1 d.p.)**

**[4 marks]**

**Question 4**

|  |  |  |  |
| --- | --- | --- | --- |
| A psychologist conducted a study into sex differences in spatial ability, which was assessed using a task called the *visual matrices test.* There were 24 participants: 12 men and 12 women. Table q4 summarises their scores. The psychologist analysed sex-differences on the visual matrices test using an independent samples *t*-test. | ***Table q4.*** Summary of visual matrices scores. | | |
| Sex | Mean | SD |
| Male | 54 | 7.5 |
| Female | 44 | 6.5 |

**(a) Use the information above to calculate the *t*-value for the *t-*test that the psychologist conducted.** Give your answer correct to 2 decimal places (2 d.p.). **SHOW YOUR WORKING in the box provided.** You should set out your calculation so that it is clear how you have obtained your answer.

**Answer (a), *t* = \_\_\_\_\_\_\_\_ (2 d.p.)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **(b)** | What is the number of degrees of freedom for this *t*-test? | | | | | **df = \_\_\_\_\_\_\_\_\_\_** | | |
| **(c)** | For this *t*-test, what is the critical value for *t* for a two-tailed test performed at the .05 level? | | | | | **Critical *t* = \_\_\_\_\_\_\_\_\_\_** | | |
| **(d)** | From tables, for the *t*-value you have calculated in part (a), which of the following apply? **Place an X under ALL that apply.** | | | | | | | |
|  | ***p* > .50** | ***p* > .05** | ***p* < .05** | ***p* < .02** | ***p* < .01** | | | ***p* < .001** |
|  |  |  |  |  |  | | |  |
| **(e)** | Which of these statements is correct? **Place an X next to ONE of the following statements** | | | | | | | |
|  | The mean difference is statistically significant. | | | | | |  | |
|  | The mean difference is not statistically significant. | | | | | |  | |

**[8 marks]**

**Question 5**

A study was conducted into the estimation of duration for complex episodes. Participants in a study viewed a film of a bank robbery. Forty-eight hours later, they were asked to estimate the duration (in seconds) of the film that they had seen. They were then given a 25-item questionnaire concerning the film. Each participant received a score for the questionnaire, which was the number of details correctly recalled (out of 25). The sex of each participant was also recorded, and the data were entered into an *SPSS* data file. The data for the first five participants are shown below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | estimated duration  in seconds | number of  details recalled | sex |  |
| 1 | 120 | 12 | male |  |
| 2 | 70 | 18 | male |  |
| 3 | 270 | 21 | female |  |
| 4 | 180 | 22 | male |  |
| 5 | 30 | 14 | female |  |

**(a)** The actual length of the film was 65 seconds. The experimenter wishes to know whether the mean estimated duration is significantly different from the actual length of 65 seconds. Which of the following tests or procedures should she use?

**Place an X under ONE OR TWO of the following options as appropriate.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Simple linear regression | Chi-square goodness-of-fit test | Chi-square test for contingency tables | One-sample  *t*-test | Independent samples  *t*-test | Pearson’s correlation  (*r*) | Related samples  *t*-test |
|  |  |  |  |  |  |  |

**(b)** The experimenter wishes to use the data recorded in her data file to determine whether participants who recalled more details tended to provide longer duration estimates for the film. Which of the following tests or procedures should she use?

**Place an X under ONE OR TWO of the following options as appropriate.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Simple linear regression | Chi-square goodness-of-fit test | Chi-square test for contingency tables | One-sample  *t*-test | Independent samples  *t*-test | Pearson’s correlation  (*r*) | Related samples  *t-*test |
|  |  |  |  |  |  |  |

**(c)** The experimenter hypothesised that the duration estimates would be normally distributed. To examine whether this was so, she divided the estimates into a series of “bins” or “intervals”, and counted the number of estimates in each bin. Which of the following tests or procedures should the experimenter use to determine whether the frequencies in these bins differ significantly from what would be expected if the data were normally distributed?

**Place an X under ONE OR TWO of the following options as appropriate.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Simple linear regression | Chi-square goodness-of-fit test | Chi-square test for contingency tables | One-sample  *t*-test | Independent samples  *t*-test | Pearson’s correlation  (*r*) | Related samples  *t-*test |
|  |  |  |  |  |  |  |

**(d)** The experimenter wishes to test whether there is a significant difference between the sexes in the average length of the duration estimates. Name **ONE parametric test** and **ONE non-parametric test** that she could use.

**Suitable parametric test: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Suitable non-parametric test: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**[5 marks]**

**Question 6**

A popular psychology book was published with two slightly different cover designs featuring a pair of human eyes with EITHER small or large pupils. In fact, the author had planned an experiment to investigate the effect of pupil size on consumer preferences. An equal number of each type of book was put on display and the number of men and women buying each design was recorded. Table Q6 shows the results from one bookshop.

***Table Q6.*** Number of customers who bought each type of book design.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Small pupils | Large pupils |  |
| Male customers | 19 | 37 |  |
| Female customers | 35 | 32 |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **(a)** | The data in the table can be correctly described as (**Place an X under ALL that apply)**: | | | |
|  | **Nominal** | **Categorical** | **Ordinal** | **Interval** |
|  |  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **(b)** | The investigators initially tested whether pupil size made a difference to the number of books sold (regardless of sex). Calculate the percentage of the **total** number of books sold that had each type of design. **SHOW YOUR WORKING in this box.** | | |
|  | **Percentage with small pupils:** | **%** | **(1 d.p.)** |
|  | **Percentage with large pupils:** | **%** | **(1 d.p.)** |

|  |  |
| --- | --- |
| **(c)** | The investigators assumed that, if the cover design made no difference to buying habits, approximately the same number of each type would be sold. What **specific** statistical test could the investigators use to test the effect of pupil size on the number of books sold? |
|  | **Suitable test:** |
|  |  |
| **(d)** | Next, the investigators used a χ2 test for contingency tables to analyse the data according to customer sex. Based on previous research, they predicted that men would be attracted to books featuring larger pupils, but women would not. State an appropriate statistical null hypothesis for this test. |
|  | **Null hypothesis:** |

**(e) Test this hypothesis by carrying out the χ2 test for contingency tables and complete (i) to (iii) below.** **SHOW YOUR WORKING in the box provided.** You shouldset out your calculation so that it is clear how you have obtained your answer. You can type any symbols in Greek or Roman letters or as words (e.g., χ2 = X2 = chi-squared).

**Answer (i) χ2 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (2 d.p.)**

**Answer (ii) Degrees of freedom = \_\_\_\_\_\_\_\_**

**Answer (iii) Place an X under ALL that apply.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | | | | |
|  | ***p* > .05** | ***p* < .05** | ***p* < .025** | ***p* < .01** | ***p* < .005** |
|  |  |  |  |  |  |

|  |  |
| --- | --- |
| **(f)** | In one sentence, state what you conclude for the test that you conducted in part (e). |
|  | **Conclusion:** |

**[15 marks]**

**Question 7**

A questionnaire was administered to 80 students. The questionnaire included six items from a psychometric scale. Responses to these items were given on a seven-point Likert scale, and were coded with the numbers from 1 to 7 when entered into *SPSS*. The *SPSS* output below is the correlation matrix for responses to these six items (A to F).



**(a)** For which item are responses *least* strongly related to the responses for the other items?

**Item \_\_\_\_\_\_\_\_**

**(b)** The scoring system for obtaining an overall score for the scale requires that Item E is “reverse coded” according to the following system:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **1 → 7,** | **2 → 6,** | **3 → 5,** | **4 → 4,** | **5 → 3,** | **6 → 2,** | **7 → 1** |

Complete the table below to show the Pearson correlation (*r*) between each pair of items *following* the reverse coding of Item E. Place one value in each blank box (i.e., write ONLYthe Pearson correlation and no other values for each pair of items).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Pearson’s *r*** | **Item A** | **Item B** | **Item C** | **Item D** | **Item E** | **Item F** |
| Item A |  |  |  |  |  |  |
| **Item B** |  |  |  |  |  |
| **Item C** |  |  |  |  |
| **Item D** |  |  |  |
| **Item E** |  |  |
| **Item F** |  |

**(c)** Cronbach’s alpha (α) could be used to assess the *internal consistency* (or “*scale reliability*”) of the psychometric scale formed by the six items shown in the table in part (b). An *SPSS* data file contains the following eight variables: Items A through F, the reverse coded version of Item E, and an overall scale score obtained by combining scores from the six items (with Item E re-coded). Which of the following variables should be used when Cronbach’s alpha is obtained? **Place an X under ALL that apply.**

|  |  |  |  |
| --- | --- | --- | --- |
| Item A | Item B | Item C | Item D |
|  |  |  |  |
| Item E | Item F | Item E (reverse-coded) | Overall scale score |
|  |  |  |  |

**(d)** Complete the following by filling in the blanks and selecting the correct option where two options are given.

|  |  |  |
| --- | --- | --- |
|  | ***Place an X under the correct option*** | |
| Higher values of Cronbach’s alpha (α) represent… | greater internal consistency. | lower internal consistency. |
|  |  |

The maximum possible value of Cronbach’s alpha (α) is **\_\_\_\_\_\_\_\_** .

A “good” degree of internal consistency is generally represented by a value of **\_\_\_\_\_\_\_\_** .

|  |  |  |
| --- | --- | --- |
|  | ***Place an X under the correct option*** | |
| Values of α are higher when more of the correlations between pairs of items are… | positive. | negative. |
|  |  |
| Values of α are higher when the strength of the correlations in this direction are… | stronger. | weaker. |
|  |  |

**[8 marks]**

**End of Examination**