# WEB PAGE FOR CHAPTER 12

## MULTIPLE CHOICE QUESTIONS

- 1 One of the assumptions the t test makes about scores obtained is that:
  - (a) variances for the two populations are equal
  - (b) sample means are equal
  - (c) population means do not differ
  - (d) population variances are not equal
- 2 If a researcher matches subjects between groups the appropriate t test is the t test for:
  - (a) independent groups
  - (b) related groups
  - (c) non-independent groups
  - (d) differences between means
- 3 If the investigator is certain that any change will be in the hypothesized direction it is appropriate to use:
  - (a) a two-tailed test
  - (b) A Mann-Whitney test
  - (c) an independent groups t test
  - (d) a one-tailed test
- 4 The most important characteristic of non-parametric tests is that they:
  - (a) make no assumption about variance in the populations
  - (b) can only be used with interval levels of measurement
  - (c) require equal population variances
  - (d) require a normal distribution
- 5 A common error in statistical analysis is to select a parametric technique even though:
  - (a) the sample size is large
  - (b) the sample includes only volunteers
  - (c) the distribution of scores is badly skewed
  - (d) a one-tailed test is possible
- 6 If there is a very small difference in means between a large samples of experimental and control subjects it is likely that the difference will be:
  - (a) statistically significant and have practical significance
  - (b) not statistically significant but have practical significance
  - (c) statistically significant but not of any practical significance
  - (d) not statistically significant and unlikely to be of practical significance
- 7 Non-parametric tests deal with:
  - (a) categorical and ordinal data only
  - (b) interval and ratio data only
  - (c) ordinal and interval data only
  - (d) all levels of data

- 8 When both an independent t test and a paired t test are computed on the same data the t value will always be larger for the paired groups.
  - (a) true
  - (b) false
  - (c) depends on df
  - (d) sometimes
- 9 Some difference tests are parametric while other difference tests are non-parametric.
  - (a) true
  - (b) false
  - (c) depends on N
  - (d) depends on equality of variance
- 10 A two-tailed test of difference between two proportions led to Z = 1.85 for its standardized difference of sample proportions. For which of the following significance levels would you reject the null hypothesis:
  - (a) .05
  - (b) none
  - (c) .02
  - (d) .01
- 11 For a one-tailed test of the difference between two means based on the related samples test with N = 300 and alpha = .01, the critical value of the test statistic is:
  - (a) 2.570
  - (b) 1.960
  - (c) 1.812
  - (d) 2.330
- 12 A known sample mean is an estimate of the unknown:
  - (a) population standard deviation
  - (b) population mean
  - (c) number in sample
  - (d) probability level
- 13 If SPSS printout shows Levine's Test for Homogeneity of variance is significant, this means:
  - (a) we have satisfied an assumption for the t test
  - (b) the two groups are very similar in terms of their standard deviations
  - (c) the two groups bare significantly different in terms of their standard deviations.
  - (d) we should abandon the t test
- 14 You would use the Mann-Whitney test when:
  - (a) you are comparing one group in a before and after situation
  - (b) you are comparing two small groups using ranked data with a skewed distribution
  - (c) you are using a one-tail test
  - (d) you are testing for difference with interval data
- 15 You would use the paired t test when:
  - (a) you are using a two-tail hypothesis
  - (b) you are comparing one group in a before-and-after situation using scale data
  - (c) you are comparing one group in a before-and-after situation using ranked data
  - (d) you are comparing two groups that are normally distributed using scale data

- 16 In a paired samples t test with 60 participants the appropriate degrees of freedom is:
  - (a) 58
  - (b) 59
  - (c) 60
  - (d) 30
- 17 200 students were tested on their relationship skills before undertaking a personal development session, after which they were tested again. Which statistical test is most relevant to determining whether the personal development course had a significant effect?
  - (a) independent t test
  - (b) Wilcoxon
  - (c) Mann-Whitney
  - (d) paired samples t test

### SPSS ACTIVITIES

- 1 Using the Chapter 12 Data File SPSS A, test the hypothesis (a) that there is a significant difference between smokers and non-smokers in the number of days absent from work last year, and (b) that there is a significant difference in age between the two genders.
- 2 Using Chapter 12 Data File SPSS B, test the hypotheses that there is a significant difference (a) between gender and starting salary, (b) between gender and pretest, (c) between smokers and non-smokers and absence, (d) between smokers and non-smokers and starting salary and (e) between smokers and non-smokers and current salary.
- 3 Using Chapter 12 Data File SPSS B, test the hypothesis that there is a significant difference between pretest and post-test when there has been a training week interpolated
- 4 Using Chapter 12 Data File SPSS B, test the hypothesis that there is a significant difference between starting salary and current salary.

### ADDITIONAL QUESTIONS/PROBLEMS

- 1 An investigator is interested in knowing whether managers who were raised under authoritarian child-rearing practices are more authoritarian in their management practices than those raised in more democratic home backgrounds. He gets 300 managers to complete questionnaires that indicate the sort of child rearing practices they experienced. From the results it was possible to divide the 300 managers into 170 who came from democratic homes and 130 from authoritarian homes. The management practices of these two groups were assessed using rating scales completed by their subordinates.
  - (a) which statistical test of differences should be used in this study?
  - (b) should a one- or two-tailed test be applied?
  - (c) what is the null hypothesis that is being tested?
  - (d) if the researcher sets a criterion significance level of p<.001 prior to conducting the study and obtains p of exactly .01, what statement is made about the rejection or retention of the null hypothesis?
  - (e) given the information about significance in (d) above is Type I or Type II error more likely?
- 2 A trial run showed that the maximum speeds of six cars of the same model were 97, 103, 107, 105, 101, 102. A second trial was conducted on the same six cars using petrol with an additive and the maximum speeds respectively were 107, 102, 105, 104, 110, 111.

- (a) which test of differences should be used?
- (b) on what assumptions does this test depend?
- (c) express a null hypothesis
- (d) what other variables or features of the design need to be standardized to ensure only the two types of fuel are influencing the results.?
- 3 Consider the tables below and answer the questions. The printout for four difference tests was taken from a file investigating attitudes to trade unions. Total Q refers to the total attitude score for each respondent with high scores reflecting more negative perceptions.

| Group Statistics |        |    |         |                |                 |  |  |  |  |
|------------------|--------|----|---------|----------------|-----------------|--|--|--|--|
|                  | gender | Ν  | Mean    | Std. Deviation | Std. Error Mean |  |  |  |  |
| TOTALQ           | male   | 61 | 33.8852 | 6.87774        | .88060          |  |  |  |  |
|                  | female | 62 | 30.7742 | 7.22341        | .91737          |  |  |  |  |

|        |  | Levene's Test<br>for Equality<br>of Variances |      | t-test         | t-test for Equality of Means |                     |                    |                          |                                |                              |  |
|--------|--|---|------|----------------|------------------------------|---------------------|--------------------|--------------------------|--------------------------------|------------------------------|--|
|        |  |   |      |                |                              |                     |                    |                          | 95% Co<br>Interval<br>Differer | onfidence<br>  of the<br>nce |  |
|        |  | F   | Sig. | t              | df                           | Sig. (2-<br>tailed) | Mean<br>Difference | Std. Error<br>Difference | Lower                          | Upper                        |  |
| TOTALQ | Equal<br>variances<br>assumed<br>Equal<br>variances<br>not assumed | 2.284   | .133 | 2.446<br>2.447 | 121<br>120.871               | .016<br>.016        | 3.1111 3.1111      | 1.27214<br>1.27163       | .59252<br>.59350               | 5.62959<br>5.62860           |  |

Independent Samples Test

| Group Statistics     |           |          |                    |                    |                    |  |  |  |  |  |
|----------------------|-----------|----------|--------------------|--------------------|--------------------|--|--|--|--|--|
| TU membership or not |           | Ν        | Mean               | Std. Deviation     | Std. Error<br>Mean |  |  |  |  |  |
| TOTALQ               | yes<br>no | 29<br>94 | 24.5172<br>34.7234 | 3.03104<br>6.35238 | .56285<br>.65520   |  |  |  |  |  |

|        |                              |                              | In                         | depende                      | ent Sampl | es Test            |                    |                          |                                      |                  |
|--------|------------------------------|------------------------------|----------------------------|------------------------------|-----------|--------------------|--------------------|--------------------------|--------------------------------------|------------------|
|        |                              | Levene<br>for Equ<br>Variane | 's Test<br>ality of<br>ces | t-test for Equality of Means |           |                    |                    |                          |                                      |                  |
|        |                              | F                            | Sig.                       | t                            | df        | Sig. (2-<br>tailed | Mean<br>Difference | Std. Error<br>Difference | 95% Conf<br>Interval o<br>Difference | fidence<br>f the |
|        |                              |                              |                            |                              |           |                    |                    |                          | Lower                                | Upper            |
| TOTALQ | Equal<br>variance<br>assumed | 22.490                       | .000                       | -8.346                       | 121       | .000               | -10.2062           | 1.22285                  | 12.62711                             | -7.78522         |
|        | Equal<br>variance<br>not     |                              |                            | -11.816                      | 100.009   | .000               | -10.2062           | .86376                   | 11.91984                             | -8.49249         |
|        | assumed                      |                              |                            |                              |           |                    |                    |                          |                                      |                  |

# T-Test

|        | Group Statistics     |    |         |                |                    |  |  |  |  |  |
|--------|----------------------|----|---------|----------------|--------------------|--|--|--|--|--|
|        | small business owner | N  | Mean    | Std. Deviation | Std. Error<br>Mean |  |  |  |  |  |
| TOTALQ | yes                  | 32 | 33.0938 | 7.60882        | 1.34506            |  |  |  |  |  |
|        | no                   | 91 | 32.0440 | 7.06936        | .74107             |  |  |  |  |  |

|        |                    |          | Inde     | ependei | nt Sample | es Test     |            |   |          |                                 |  |  |  |
|--------|--------------------|----------|----------|---------|-----------|-------------|------------|---|----------|---------------------------------|--|--|--|
|        |                    | Levene's | Test     |         |           |             |            |   |          |                                 |  |  |  |
|        |                    | for Equa | ality of |         |           |             |            |   |          |                                 |  |  |  |
|        |                    | Variance | es       | t-test  | for Equa  | ality of Me | ans        |   |          |                                 |  |  |  |
|        |                    |          |          |         |           |             | Mean       | 95%<br>Inter<br>Diffe<br>Std.<br>Iean Error |          | Confidence<br>al of the<br>ence |  |  |  |
|        |                    |          |          |         |           | Sig. (2-    | Difference | Differenc                                   |          |                                 |  |  |  |
|        |                    | F        | Sig.     | t       | df        | tailed)     |            | e   |          |                                 |  |  |  |
|        |                    |          |          |         |           |             |            |   | Lower    | Upper                           |  |  |  |
| TOTALQ | Equal<br>variance: | .743     | .390     | .708    | 121       | .480        | 1.0498     | 1.48210                                     | -1.88441 | 3.98400                         |  |  |  |
|        | Equal variance;    | -        |          | .684    | 51.056    | .497        | 1.0498     | 1.53570                                     | -2.03317 | 4.13276                         |  |  |  |
|        | not<br>assumed     |          |          |         |           |             |            |   |          |                                 |  |  |  |

## T-Test

|        | Group Statistics                       |    |         |                |            |  |  |  |  |  |
|--------|--|----|---------|----------------|------------|--|--|--|--|--|
|        | previous experience<br>of unemployment | NT | Maar    | Std. Deviation | Std. Error |  |  |  |  |  |
|        |  | N  | Mean    |                | Mean       |  |  |  |  |  |
| TOTALQ | yes                                    | 29 | 32.3103 | 6.77234        | 1.25759    |  |  |  |  |  |
|        | no                                     | 94 | 32.3191 | 7.35755        | .75887     |  |  |  |  |  |

|        |  |                           |                               | Inde                         | pendent S     | Samples To          | est                |                          |                                  |                          |  |
|--------|--|---------------------------|-------------------------------|------------------------------|---------------|---------------------|--------------------|--------------------------|----------------------------------|--------------------------|--|
|        |  | Leven<br>for Eq<br>Variar | e's Test<br>uality of<br>Ices | t-test for Equality of Means |               |                     |                    |                          |                                  |                          |  |
|        |  | F                         | Sig.                          | t                            | df            | Sig. (2-<br>tailed) | Mean<br>Difference | Std. Error<br>Difference | 95% Cor<br>Interval<br>Differenc | nfidence<br>of the<br>ce |  |
|        |  |                           |                               |                              |               |                     |                    |                          | Lower                            | Upper                    |  |
| TOTALQ | Equal<br>variance<br>assumed<br>Equal<br>variance<br>not | 1.542                     | .217                          | 006<br>006                   | 121<br>50.104 | .995<br>.995        | 0088<br>0088       | 1.53500<br>1.46882       | -3.04774<br>-2.95886             | 3.03013<br>2.94125       |  |
|        | assumed  |                           |                               |                              |               |                     |                    |                          |                                  |                          |  |

- (a) How many respondents in total were involved in the study?
- (b) Is TotalQ the IV or DV?
- (c) For each of the four tests, state a null hypothesis
- (d) For each of the four tests make a statement about the results and the implications for the null and alternate hypotheses.
- (e) With reference to Levine's test, which line in the lower table is to be used in each of the four sets of tables? What are the implications of the Levine test in each of the four?
- 4 A random sample of customers of a national bank were surveyed after they had been served to determine how long they waited in seconds for service in line under the bank's existing queueing system 1. The bank then instituted a new queueing system (2) and resurveyed the same customers. Printout of the data obtained is located in the tables below. Review the printout and answer the questions.

|           |                   | Mean    | N   | Std. Deviation | Std. Error<br>Mean |
|-----------|-------------------|---------|-----|----------------|--------------------|
| Pair<br>1 | queueing system 1 | 50.6758 | 438 | 2.88052        | .13764             |
|           | queueing system 2 | 46.8356 | 438 | 2.99204        | .14297             |

#### Paired Samples Statistics

|      |                     | Ν   | Correlation | Sig. |
|------|---------------------|-----|-------------|------|
| Pair | queueing system 1 & |     |             |      |
| 1    | queueing system 2   | 438 | .532        | .000 |

#### Paired Samples Test

|      |                     |        | Pair      | ed Differei | nces                              |        |       |     |          |
|------|---------------------|--------|-----------|-------------|-----------------------------------|--------|-------|-----|----------|
|      |                     |        |           | Std.        | 95% Confidence<br>Interval of the |        |       |     |          |
|      |                     |        | Std.      | Error       | Difference                        |        |       |     | Sig. (2- |
|      |                     | Mean   | Deviation | Mean        | Lower                             | Upper  | t     | df  | tailed)  |
| Pair | queueing system 1 - |        |           |             |                                   |        |       |     |          |
| 1    | queueing system 2   | 3.8402 | 2.84167   | .13578      | 3.5733                            | 4.1070 | 28.28 | 437 | .000     |

(a) Which test of differences was used and why?

(b) Identify the IV and DV.

(c) How many customers were surveyed?

(d) Propose a null hypothesis.

- (e) Under which queueing system would you waste significantly more time? Which one would you recommend to the CEO? Explain why, quoting your evidence.
- 5 The following printout refers to applicants for public service management trainee posts from two universities ranked as one batch after undergoing a number of selection procedures with 1 being most preferred applicant and 30 the least preferred. Answer the questions below after inspecting the tables.

## Mann-Whitney Test

| Ranks                 |                      |    |           |              |  |
|-----------------------|----------------------|----|-----------|--------------|--|
|                       | University attended  |    | Mean Rank |              |  |
|                       |                      | Ν  |           | Sum of Ranks |  |
| ranked public service | Egghead university   | 14 | 19.14     | 268.00       |  |
| selection test score  | Birdbrain University | 16 | 12.31     | 197.00       |  |
|                       | Total                | 30 |           |              |  |

|                                | ranked public<br>service<br>selection test<br>score |
|--------------------------------|---|
| Mann-Whitney U                 | 61.000  |
| Wilcoxon W                     | 197.000   |
| Ζ                              | -2.120  |
| Asymp. Sig. (2-tailed)         | .034  |
| Exact Sig. [2*(1-tailed Sig.)] | .034 <sup>a</sup>                                   |

- (a) Explain why Mann-Whitney was chosen.
- (b) What is the null hypothesis for this study?
- (c) Interpret the result and the implications for the selectors.

### Answers to additional questions

- 1 (a) Independent t test.
  - (b) One (from wording of question).
  - (c) That managers from authoritarian homes are not significantly more authoritarian in their management practices than those from democratic homes.
  - (d) Null retained.
  - (e) Type II.
- 2 (a) Repeated measures Wilcoxon non-parametric test.
  - (b) Used as small numbers involved and normality questionable as is homogeneity of variance. Data will need to be ranked.
  - (c) That there is no significant difference in mean ranked speed between the two fuel conditions.
  - (d) You could list quite a few. These spring readily to mind one driver for all cars; same weather conditions, same testing circuit, same car weight and equipment, etc. You add more.
- 3 (a) 123
  - (b) DV
  - (c) All hypotheses on lines 'that there is no statistically significant difference between X and Y in mean TotalQ
  - (d) Statistical significance for gender and TU membership with males significantly more anti than females and TU members more pro than non-members. Small business ownership and experience of unemployment produced no significant differences.
  - (e) Only TU membership uses lower line having a significant F.
- 4 (a) Repeated measure (Paired Sample t test) as same group tested twice.
  - (b) IV = queueing systems; DV = time in queue.
  - (c) 438
  - (d) That there is no statistically significant difference in mean wait time between the two systems.
  - (e) System 1 has significantly higher wait time (p < .001). Recommend system 2.
- 5 (a) Small numbers; normality not assumed.
  - (b) That applicants from both universities are random samples from one population.
  - (c) Significant result (p<.034) suggests that the lower mean rank (more preferred applicants) tend to come from Birdbrain University.

### ANSWERS TO MULTIPLE CHOICE QUESTIONS

1 (a), 2 (b), 3 (d), 4 (a), 5 (c), 6 (c), 7 (a), 8 (a), 9 (a), 10 (b), 11 (d), 12 (b), 13 (c), 14 (b), 15 (b), 16 (b), 17 (d).