

Common Foundation Programme 2002-3

Research and Critical Skills 8b

26 November 2002

MCQ and EMI Self Test

At St. George's we use two types of automatically marked question. We use multiple choice questions of the stem and 5 branch type, where each stem may be True or False, usually referred to as "MCQs". We use extended matching items questions, where there is a scenario and any number of questions with answers chosen from a long list, usually referred to as "EMIs". In our usual practice, MCQs have negative marking, i.e. you get +1 for a right answer and -1 for a wrong answer, and EMIs do not have negative marking.

MCQs

Each branch is True or False.

- 1 In a clinical trial of a drug to improve the survival rate following heart attacks:
 - (a) cases receiving the drug should be matched with controls by age and sex.
 - (b) subjects should be a random sample of patients from a large population.
 - (c) if possible, written informed consent should be obtained before patients can be admitted to the trial.
 - (d) subjects should be told whether they are receiving the test drug or not.
 - (e) the admitting clinician should know what drug the patient will receive before admitting to the trial.

- 2 In a double blind clinical trial:
 - (a) the patients do not know which treatment they receive.
 - (b) each patient receives a placebo.
 - (c) the patients do not know they are in a trial.
 - (d) each patient receives both treatments
 - (e) the clinician assessing the patients' condition does not know which treatment the patient has received.

3. The median estimated from a sample:
 - (a) is always equal to an actual observation.
 - (b) is close to the mean if the distribution is symmetrical.
 - (c) is less than the mean if the distribution is positively skewed.
 - (d) is the most frequently occurring value.
 - (e) is greater than or equal to at least 50% of the observations.

4. The standard deviation is:
- (a) a measure of variability.
 - (b) the square root of the variance.
 - (c) twice the standard error.
 - (d) in the same units as the observations.
 - (e) half the range.
5. A 95% reference interval:
- (a) can be calculated from the mean and standard deviation for data which follow a Normal distribution.
 - (b) contains the values for all healthy subjects.
 - (c) will automatically exclude values for any subject who is ill.
 - (d) is also known as a "normal range".
 - (e) should be estimated from a representative sample.
6. The standard error of the mean of a sample:
- (a) is the accuracy with which a single observation is measured.
 - (b) measures the variability of the observations themselves.
 - (c) depends on the square root of the sample size.
 - (d) is a measure of how far apart the sample mean and the population mean are likely to be.
 - (e) is greater than the standard deviation of the population estimated from the sample.
7. In a study of 88 births to women with a history of thrombocytopenia, the same condition was recorded in 20% of babies (95% confidence interval 13% to 30%) (*NEJM*,1990,323:229-235).
- (a) 5% of such women have a probability of having a baby with thrombocytopenia which is not between 13% and 30%.
 - (b) The rate of thrombocytopenia in 95% of samples of the same size will be between 13% and 30%.
 - (c) If the sample were increased to 880 births, the 95% confidence interval would be narrower.
 - (d) We would be likely to observe data like the sample if between 13% and 30% of births to such women in the area had thrombocytopenia.
 - (e) It would impossible to get these data if the rate for all women was 10%.

8. If the difference between the means of two samples of observations were not significant:
- (a) any difference between the two samples must be very small.
 - (b) there would be no difference between the means of the populations from which the samples come.
 - (c) the two samples must have the same mean.
 - (d) any difference between the populations from which the samples come is unimportant.
 - (e) there is insufficient evidence to conclude that the populations have different means.

EMIs

For each question choose one answer from the following list:

- a) allocation according to patient's choice
- b) allocation according to physician's judgement
- c) alternate allocation
- d) bar chart
- e) Binomial distribution
- f) double blinding
- g) histogram
- h) interquartile range
- i) line graph
- j) little or no evidence
- k) matching
- l) measurement error
- m) median
- n) negatively skew
- o) no blinding
- p) Normal distribution
- q) pie chart
- r) positively skew
- s) proof that there is no difference
- t) random allocation
- u) single blinding
- v) some evidence
- w) strong evidence
- x) symmetrical
- y) very strong evidence
- z) weak evidence

SCENARIO ONE

A clinical trial was carried out to compare two prescribing strategies for childhood acute otitis media (glue ear): immediate antibiotics or delayed antibiotics (antibiotic prescription to be collected at parents' discretion after 72 hours if child still not improving).

315 children aged between 6 months and 10 years presenting with acute otitis media were allocated to one or other strategy. The outcome measures were time until symptoms ceased, absence from school or nursery, and paracetamol consumption.

Parents were asked to keep diaries of the child's symptoms and return to normal activities.

Children prescribed antibiotics immediately had shorter mean length of illness (1.1 days (95% confidence interval 0.54 to 1.48, $P < 0.01$)), fewer nights disturbed (0.72 (0.30 to 1.13, $P < 0.01$)), and slightly less paracetamol consumption (0.52 spoons/day (0.26 to 0.79), $P < 0.01$). The number of school days missed was mean (range) 1.97 (0-8) in the immediate group and 2.15 (0-13) in the delayed group 0.18 (0.76 to 0.41), $P = 0.56$. Parents of 36/150 of the children given delayed prescriptions used antibiotics, and 77% were very satisfied. Fewer children in the delayed group had diarrhoea (14/150 (9%) v 25/135 (19%), $P = 0.02$).

(*British Medical Journal* 2001; 322: 336-342)

QUESTIONS ON SCENARIO ONE

9. What method should be used to allocate patients to treatments in a study of this type?
10. What kind of blinding or masking is used in this trial?
11. For the number of days off school, which term best describes the shape of the distribution which is suggested by the data given?
12. Which term best describes the strength of evidence that the delayed antibiotics increases the mean length of the illness?
13. Which term best describes the strength of evidence that the delayed antibiotics increases the time off school?
14. Which term best describes the strength of evidence that the delayed antibiotics decreases the risk of diarrhoea?

SCENARIO TWO

A study was carried out to investigate the possibility of a peripheral mechanism in cardiac opioid withdrawal. Rats which had been made dependent on morphine or given a placebo were used.

Naloxone (Nx), naloxone methiodide (NxM) and N-methyl levallorphan (NML), quaternary derivatives of Nx and levallorphan, respectively, that do not cross the blood-brain barrier, were administered to morphine-dependent rats.

Animals received subcutaneous injections of saline, Nx (1 mg/kg), NxM (5 mg/kg) or NML (5 mg/kg) and were decapitated 30 min later. Catecholamines and their metabolites were determined in the right ventricle and weight loss was recorded.

The following graph was produced:

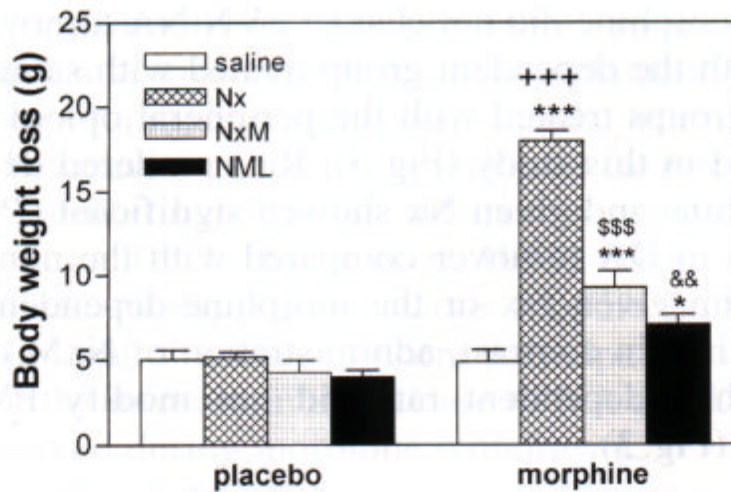


Fig. 1. Body weight loss in placebo-treated and in morphine-dependent rats 30 min after s.c. injections of saline, naloxone (Nx 7 mg/kg), naloxone methiodide (NxM 5 mg/kg) or N-methyl levallorphan (NML 5 mg/kg). Means \pm SEM, n=6-8; * P<0.05, *** P<0.001 vs. morphine group given saline; +++ P<0.001 vs. placebo group given Nx; \$\$\$ P<0.001 vs. placebo group given NxM; && P<0.01 vs. placebo group given NML. All other comparisons with saline or placebo not significant.

(Archives of Pharmacology 2001; 364:193-198)

QUESTIONS ABOUT SCENARIO TWO

15. Which term best describes the type of graph?
16. Which term best describes the strength of the evidence that in morphine tolerant rats Nx produces greater weight loss than saline?
17. Which term best describes the strength of the evidence that in morphine tolerant rats NxM produces greater weight loss than saline?
18. Which term best describes the strength of the evidence that in morphine tolerant rats NML produces greater weight loss than saline?
19. Which term best describes the strength of the evidence that morphine tolerant rats and rats given placebo lose weight differently when given saline?
20. Which term best describes the strength of the evidence that morphine tolerant rats and rats given placebo lose weight differently when given NML?

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Solution to MCQ and EMI Self Test

MCQ Marking

1. FFTFF 2. TFFFT 3. FTTFT 4. TTFTF
5. TFFTT 6. FFTTF 7. FFTTF 8. FFFFT

Score +1 for a correct answer, 1 for an incorrect answer, and 0 if you did not answer. You can rate your performance as follows:- below 15: work much harder, 15-19: work harder, 20-24: adequate, 25-24: good, 30-34: excellent, 35 or more: take over the class.

Notes on the questions

- (a) trials are not usually matched (b) we usually take all the suitable patients we can get. There are no suitable lists for random sampling (c) informed consent should always be obtained if possible for ethical reasons (d) trials should be blind if possible (e) this could lead to bias.
- (a,e) by definition (b) not necessary, but may be done if the two treatments are easy to distinguish, or in a cross-over trial (c) patients usually have to give informed consent (d) this is a cross-over trial, which may be double blind or may not.
- (a) in even sized samples it is the average of the two central values, which could be different (b, c) standard properties of median and mean (d) this is the mode (e) by definition, also less than or equal to at least 50% of the observations.
- (a) measures variation about the mean (b) by definition (c) not unless the sample size is 4 (d) its advantage over variance as a summary statistic (e) we expect the range to exceed 4 standard deviations for most samples.
- (a) yes, it is mean - 1.96 S.D. to mean + 1.96 S.D., or more loosely mean - 2 S.D. to mean + 2 S.D. (b) excludes 5% of 'normal' subjects (c) the range is calculated for healthy subjects, but may contain many unhealthy subjects, depending on the overlap between the 'healthy' and 'unhealthy' distributions (d) an alternative, older name (e) if the sample is not representative of the normal or healthy population, how can it tell us what values that population will have?
- (a) this is measured by the measurement error, the standard deviation of repeated measurements on the same subject (b) the standard deviation does this (c) s/\sqrt{n} (d) they are closer than 1 standard error for about 2/3 of samples (e) less, s/\sqrt{n} .
- (a) the confidence interval is an estimate of the overall rate, which applies to all women (b) they will be more widely scattered, each sample's confidence interval containing the population value with probability 95% (c) the standard error would reduce (d) by definition (e) unlikely, but not impossible.
- (a) depends on the sample size. For small samples even quite large observed differences may be not significant (b) not significant does not mean no difference exists, it means we have failed to show that there is a difference (c) the sample means may be different, although as the difference is not significant they are no more different than we would expect by chance if the population means were the same (d) the difference may be quite large and very important (e) see b.

EMI Marking

Score +1 for each correct answer. You can rate your performance as follows:- below 5: work much harder, 5-6: work harder, 7-8: adequate, 9-10: good, 11-12: excellent.

9. **t** (random allocation) trials should be randomised wherever possible.
10. **o** (no blinding) everybody involved knows the treatment.
11. **r** (positively skew) the mean is close to the lower end of the range.
12. **w** (strong evidence) $P < 0.01$.
13. **j** (little or no evidence) $P > 0.1$.
14. **v** (some evidence) P between 0.01 and 0.05.
15. **d** (bar chart) a bar chart shows the relationship between variable, a histogram shows the frequency distribution for a single variable.
16. **y** (very strong evidence) $P < 0.001$.
17. **y** (very strong evidence) $P < 0.001$.
18. **v** (some evidence) P between 0.01 and 0.05.
19. **j** (little or no evidence) $P > 0.1$.
20. **w** (strong evidence) $P < 0.01$.