**Pearson Edexcel Level 3 Certificate in Mathematics in Context**

**Comprehension teaching and practice material**

These materials are designed to support teaching and learning of mathematical comprehension skills. They may be used for classroom discussion, teaching and learning and/or student practice. They provide comprehension practice on four topics as follows:

Waste and recycling

Earthquakes

Winter Olympics

**Ebola**

Each zip file contains four types of material as follows:

Teacher notes

Comprehension passage and questions

Mark scheme

Spreadsheet(s)

These teacher notes suggest other supporting resources including videos. The teacher notes also provide a mapping of the task questions to GCSE Mathematics (9-1) and the current GCSE Statistics and indicate where skills specific to Mathematics in Context are required. Some tasks’ questions include more challenge than others and this is made clear within the teacher notes.

Students should have access to formulae where required. The formulae sheet is  provided in the specification (Appendix 3) and in the sample assessment materials.

**Ebola**

**Background**

This task takes data from the recent (2014) Ebola outbreak in West Africa and from outbreaks of influenza to form the basis of some mathematical modelling and data analysis.

The first part of the task deals with data analysis; the second, a challenging part, with mathematical modelling via recurrence relations, although much of the challenge deals with extracting information from curves rather than algebraic manipulation. However, students should have done the sequences/series exercises first.

Two models are included - exponential growth which can be used for the initial stage of the spread - and the SIR model which is more challenging, but does give a good qualitative description of the way the disease spreads in terms of time dependence.

The SIR model assumes no change in the overall population - no migration or births or deaths from other than the disease under study.

**Resources**

There is a clear introduction at

<http://www.telegraph.co.uk/news/worldnews/africaandindianocean/10997859/Ebola-outbreak-explained-in-60-seconds.html>

There is a good simulation applet which is free and easy to run at [http://www.shodor.org/featured/DiseaseModel/model/](http://www.shodor.org/featured/DiseaseModel/model/%20)

A simple Excel spreadsheet is included with the resources and can be used to examine the effect of varying the conditions with the SIR model. Students should also become aware of the limitations of the spreadsheet.

**Comments on the questions**

**1** (a) Interpret Table 1 and convert to a fraction.

(b) Use the given table to calculate an estimate of the mean.

(c) State advantage of one type of average. The estimate of the mean is affected by the assumed width of the final interval in the table. The accompanying spreadsheet shows this using several different assumptions.

**2** (a) Use Table 2 to construct a cumulative frequency table and then draw a cumulative frequency diagram.

(b) Use the cumulative frequency diagram to produce the box plot. The comment about assumptions is how to deal with the end points.

(c) This requires a comment about the medians and a comment on the IQRs in context.

*The remainder of this task requires confidence in algebra and subscript notation.*

**3**  (a) Substitute for *b*, *I*1 and *n* (= 15) into the given expression.

(b) Use the answer to part (a). In another 2 weeks the number would be about 40 and so on.

(c) Use the model with *b* = 1.04, *I*1 = 1 and *n* = 41

(d) The exponential model assumes indefinite growth; the model assumes that the rate of infection is constant, but is more likely to depend on the number of people left in the population.

**4** This time the model is used on the cumulative number of deaths based on a daily increase of 1.98%. WHO data indicates that about 50% of those who get infected do, in fact, survive.

**5**  (a) *I*1 is small as it reflects the fact that there are usually a small number of infectives at the start of an outbreak (for Ebola, it may be just one person bitten by a monkey)., because no-one has recovered (died) yet. because initially the vast majority of the population has not yet been infected.

(b) This requires some manipulation of equation (1). The percentage change is  .

(c) (3) describes how the number of removed varies.

(d) Substitute the given values into (1) to (3) and then (1) again.

**6** (a) (i) Read directly from the graph.

These have been drawn from the Excel program. The answers should be given in context.

(ii) Use the fact that *S + I + R* = 2 million

(iii) The *I* and *R* graphs should be described with some interpretation.

(b) Use the fact the *S + I + R* = total population.

(c) This testing part requires the use of equation (2):

*In*+1 = *In* = *I*max

*I*max = *I*max + *aS*n*I*n − *bI*n

*aS*n*I*n = *bI*n

*S*n = *b/a*

**Analysis based on GCSE (9–1) Mathematics and GCSE Statistics (current specification)**

**Task: Ebola**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Question** |  | **Demand/Content** | | | | |
|  |  | **GCSE Maths** | | **GCSE Stats** | | **Other** |
|  |  | **F** | **H** | **F** | **H** |  |
| **1 (a)** | Interpret table 1 and convert to a fraction | ✓ |  |  |  | F tier |
| **(b)** | Estimate mean | ✓ |  | ✓ |  | A3 |
| **(c)** | Advantage of a median | ✓ |  | ✓ |  | A5 |
| **2 (a)** | Cumulative frequency |  | ✓ | ✓ |  | A3 |
| **(b)** | Box plot |  | ✓ | ✓ |  | A4 |
| **(c)** | Compare using a box plot |  | ✓ |  | ✓ | A5 |
| **3 (a)** | Substitute in an algebraic expression | ✓ |  |  |  | SG7 |
| **(b)** | Comment | ✓ |  |  |  | SG7 |
| **(c)** | Substitute | ✓ |  |  |  | SG7 |
| **(d)** | Comment |  | ✓ |  |  | SG1 |
| **4** | Substitute |  | ✓ |  |  | SG7 |
| **5 (a)** | Comment |  | ✓ |  |  | SG7 |
| **(b)** | Manipulation (and subscripts) |  | ✓ |  |  | SG7 |
| **(c)** | Comment |  | ✓ |  |  | SG7 |
| **(d)** | Subscripts |  | ✓ |  |  | SG7 Requires knowledge of subscripts |
| **6 (a)(i)** | Read from a graph | ✓ |  |  |  | F tier |
| **(ii)** | Comment | ✓ |  |  |  | SG7 |
| **(iii)** | Comment | ✓ |  |  |  | SG7 |
| **(b)** | Comment |  | ✓ |  |  | SG7 |
| **(c)** | Algebraic manipulation |  |  |  |  | SG7 Requires knowledge of subscripts and algebraic manipulation |