INSTITUTE AND FACULTY OF ACTUARIES

EXAMINATION BOOKLET – ONLINE VERSION

November 2015

CA2: Model Documentation, Analysis and Reporting

Paper 1

This document must be destroyed after the examination has been completed

Please note that the content of this booklet is confidential and students are not to discuss or reveal the contents under any circumstances.

Examination instructions

1. You must download the exam assignment at the start of the exam time stated. All times given are UK times. Please note that it will not be available to you at any other time. The morning sitting will take place at 09.00hrs to 12.15hrs and the afternoon sitting is 14.00hrs to 17.15hrs. The exam paper is three hours plus 15 minutes reading time. **It is your responsibility to ensure that all of your files are submitted within this time limit. Failure to do so will result in your assignment not being marked.** To submit your assignment please upload your documents as instructed or e-mail your files to online_exams@actuaries.org.uk. Only your first submission will be accepted and marked.
2. You may refer to any written or electronic reference material provided as part of the CA2 exam. You have been supplied with all data electronically at the start of the exam time. It is recommended that you use the first 15 minutes as reading and planning time.
3. The work you submit MUST be saved in Microsoft 2007 format, i.e. using docx (Word) or xlsx (Excel) file extensions. Do not embed documents in your spreadsheet.
4. You must build your model from scratch and not use an imported e-template.
5. You are required to work through the exam assignment without assistance from another person. The assessment regulations of the Institute and Faculty of Actuaries apply as set out in the Examination Regulations except that you may refer to reference material. By submitting your files you are confirming that all material is entirely your own work and you wish this to be taken into account for this assessment.
6. Save your work regularly. You do not have to print out your work but you may choose to do so from time to time if you prefer to check a printed copy. Saving your work is your responsibility so failure to do so will not be a significant mitigating circumstance.
7. You must not discuss or disclose the material. To do otherwise may lead to a disciplinary case.
8. You are reminded that by undertaking this exam you are bound by the Institute and Faculty of Actuaries' Examination Rules and Regulations.
9. At the end of the allotted time or when you have completed your exam, you need to submit your work.

   Your filenames must include your ARN (e.g. Summary_90XXXXX.docx) and each file should also contain your ARN as a header or footer on at least one page. You will receive an acknowledgement by email from the Online Exams Team confirming receipt. The Online Exams Team will send you an email after the exam requesting you to delete all your files relating to the exam, together with your planning notes and any print-outs. If you experience difficulties in submitting your work, you must inform the Online Exams Team immediately at online_exams@actuaries.org.uk or T. +44 (0)1865 268 255.

Professional behaviour is mandatory and no material relating to the exam may be disclosed or discussed with others, nor used in a further attempt at the exam.

Failure to comply with this will be deemed to be a breach of examination regulations and may result in disciplinary action.

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Exam requirements

1. Read the background document, which describes the scenarios that need to be modelled and documented for this project.

2. Construct a spreadsheet model that produces the following calculations and charts. You should ensure that your spreadsheet contains appropriate self-checks and that you have performed robust reasonableness checks at each stage of your calculations.

(i) Check the 1985 survey data provided and amend any corrupt data as necessary. [2]

(ii) (a) Convert the 1985 survey results from square miles ($miles^2$) to square kilometres (km^2) using a conversion factor of 1 km = 0.62 miles.

(b) Restate the 1985 survey results using the same postal areas as 2015. [3]

(iii) Check the 2015 survey data provided and amend any corrupt or missing data as necessary. [6]

(iv) Calculate the average number of Blue Birds per km^2 in 2015 for each postal area in Actuaria and compare with the 1985 results. You should assume that the Actuaria Central Statistics Office information is correct. *[Hint: the total number of birds in each area can be estimated by multiplying the total population of each area by the total successful sightings for that area, divided by the total responses received for that area. You can assume that only one bird is seen for each sighting.]* [6]

(v) (a) Construct an appropriate chart illustrating the results of the two surveys.

(b) Compare the two survey results and comment on whether a northerly shift in the density of the Blue Birds has been observed. [3]

(vi) Project the Blue Bird population density forward to 2025, by postal area. [7]

(vii) Construct an appropriate chart comparing all three sets of results. [2]

Marks available for spreadsheet model and checks:

Accurate completion of the above model and checks	**[29]**
Demonstration of good modelling steps and practice	**[7]**
Other (non-data) checks	**[8]**

[Sub-total 44]

3. Produce an audit trail for your spreadsheet model which includes the following:

- purpose of the model
- data and assumptions used
- data validation
- methodology, i.e. description of how each calculation stage in the model has been produced
- explanation of the checks performed

You should ensure that your audit trail is suitable for both a senior actuary, who has been asked to approve your work, and a fellow student, who has been asked to peer review and correct your model, or to continue work on it, or to use it again for a similar purpose in the future.

Marks available for audit trail:

Audit approach

- **Fellow student can review and check methods used in the model [8]**
- **Senior actuary can scrutinise and understand what has been done [8]**
- **Written in clear English [4]**
- **Written in a logical order [3]**

Audit content

- **All steps clearly explained [7]**
- **Clear signposting included throughout [5]**
- **Statement of assumptions made [5]**
- **All model steps accurately covered [16]**

[Sub-total 56]

[Total 100]

Background

The Actuaria Society for the Protection of Birds (ASPB) is concerned with the welfare of wild birds in Actuaria and as part of its activities conducts wildlife surveys to assess the health and distribution of bird populations. An extensive survey of the Blue Bird was undertaken in 2015, which updates a survey last carried out in 1985.

The 1985 survey showed that the Blue Bird population density was high in the south of Actuaria but decreased towards the north of the country.

You are an actuarial student working for a consultancy in Actuaria. The ASPB has approached your boss, a qualified actuary, and asked whether it is possible to use the results of the survey to construct a profile of the Blue Bird population density in Actuaria. In particular, it is interested in the geographical distribution from south to north of the country and how that has changed since 1985.

Each survey makes use of the postcode system in Actuaria, which is relatively simple. There are eight postal areas which are generally in order from north to south, starting with AB in the extreme north, then CD next, and so on, until the most southerly area of PQ is reached. These postal areas are further divided into postcodes. For example, the area AB consists of AB1, AB2 and AB3. There are 33 postcodes in total and these are split over the eight postal areas.

In addition, the census information for Actuaria has been provided by the Actuaria Central Statistics Office (ACSO) and gives the population and land area for each postal area as used in the recent 2015 census.

Data is provided electronically and a copy is included in this booklet.

2015 survey

The 2015 survey was conducted online by asking the citizens of Actuaria to check if they could see at least one Blue Bird during one particular hour on a particular day in 2015. The survey asked the citizens to confirm whether or not the Blue Bird was observed and also to submit the location of the observation based on the relevant postcode to provide a geographical assessment. The results of the survey have been provided by the ASPB.

Your boss has asked you to determine the density of Blue Birds for each postal area.

1985 survey

The results of the original survey in 1985 have also been provided by the ASPB. These are on a slightly different basis as the survey was before Actuaria adopted the metric system and the survey areas were not as detailed as in the 2015 survey. Your boss has asked you to adjust the 1985 survey results to make them comparable to the 2015 survey and compare the two sets of results.

2025 projection

Finally, your boss has asked you to use the 2015 survey results to project the population density of Blue Birds by postal area each year to the year 2025, subject to a maximum population density in any one postal area of 120 birds per km^2. The ASPB has estimated that:

- on average, every 2 birds in each postal area will increase to 2.1 birds each year.
- 2% of the population of Blue Birds in each postal area will migrate northerly to the next area in Actuaria each year.
- Blue Birds also migrate northerly into the most southern postal area of Actuaria from the neighbouring country of South Actuaria at a rate of 2% of the population of South Actuaria each year.
- South Actuaria has a land area of 10,000 km^2 and a bird density of 100 per km^2 in 2015.

Unfortunately, your boss is out of the office visiting a client and cannot be contacted for the next three hours. She would like the above calculations finished and documented in the audit trail ready for her return.

Data

2015 Survey of the Blue Bird

Postcode	Area	Total responses	Sightings
AB1	AB	1,629	90
AB2	AB	2,445	111
AB3	AB	4,741	253
CD1	CD	19,555	1,741
CD2	CD	16,896	1,540
CD3	CD	-	1,411
CD4	CD	16,403	1,703
CD5	CD	10,840	993
EF1	EF	29,936	4,291
EF2	EF	14,285	2,429
EF3	EF	29,398	4,161
GH1	GH	79,092	17,732
GH2	GH	107,392	19,446
GH3	GH	20,526	4,617
GH4	GH	39,397	6,796
GH5	GH	43,313	8,433
JK1	JK	24,340	7,482
JK2	JK	62,324	16,560
JK3	JK	54,679	17,473
JK4	JK	72,080	22,922
LM1	LM	76,242	19,500
LM2	LM	5,680	1,404
LM3	LM	10,681	2,838
LM4	LM	7,951	2,099
LM5	LM	37,862	10,261
LM6	LM	58,870	-
NO1	NO	18,606	10,144
NO2	NO	21,398	13,308
NO3	NO	52,194	32,879
NO4	NO	38,898	22,783
PQ1	PQ	18,606	11,375
PQ2	PQ	14,778	9,570
PQ3	PQ	8,232	6,329

Source: Actuaria Society for the Protection of Birds (ASPB)

1985 Survey of the Blue Bird

Area	Birds per mile^2
AB CD	0.20
EF GH	110
JK LM	7.60
NO	26.20
PQ	32.30

Source: Actuaria Society for the Protection of Birds (ASPB)

2015 Census

Area	Population	Size km^2
AB	1,000,000	30,000
CD	1,500,000	10,000
EF	2,000,000	20,000
GH	7,000,000	40,000
JK	5,000,000	35,000
LM	6,000,000	25,000
NO	4,000,000	30,000
PQ	2,000,000	15,000

Source: Actuaria Central Statistics Office (ACSO)

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