

# INSTITUTE AND FACULTY OF ACTUARIES

**September 2017**

## **CA2: Model Documentation, Analysis and Reporting**

### **Paper 1**

Time allowed: 3 hours + 15 minutes reading time

#### **INSTRUCTIONS TO THE CANDIDATE**

1. You have 15 minutes reading time at the start of the examination in which to read the questions. You are strongly encouraged to use this time for reading only, but notes may be made. You then have 3 hours to complete the paper.
2. You must build your model from the beginning and not use an imported e-template.

Your file names must include your ARN, the name of the document and the paper sat (e.g. 9000000-Summary-Paper1) and each file should contain your ARN as a header or footer.

Please note that the content of this booklet is confidential and students are not to discuss or reveal the contents under any circumstances nor are they to be used in a further attempt at the exam.

If you encounter any issues during the examination please contact the Online Education team at [online\\_exams@actuaries.org.uk](mailto:online_exams@actuaries.org.uk) T. 0044 (0) 1865 268 255

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## Exam requirements

1. Read the background document, which describes the calculations 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) For each type of food, calculate the number of items sold in each month during the year. [2]
  - (ii) Calculate the revenue received and the costs incurred each month during the year. [2]
  - (iii) Using the numbers produced in (ii), project the bank balance each month allowing for Grace to pay herself a salary of \$1,000 at the end of each month. [6]
  - (iv) Calculate the accumulated values at the end of the year of all the monthly income less expenses for the business using the methodology prescribed by the Revenue and Customs office (RC). [5]
  - (v) Using the numbers produced in (iii) and (iv), determine Grace's projected tax bill for the year (salary plus profit taxes). [2]
  - (vi) Repeat (iii), (iv) and (v) to determine the salary Grace should pay herself so that the company's projected bank account balance at the end of the year would be exactly equal to the expected total (salary plus profit) tax bill. [3]
  - (vii) Repeat (iii), (iv) and (v) to determine the salary Grace should pay herself so that the profit tax under RC rules at the end of the year is expected to be zero. [3]
  - (viii) Produce a chart that shows the monthly projection of the bank account balance during the year under all three scenarios. [3]
  - (ix) Produce a chart that shows the total tax (split by salary and profit) that Grace has to pay under all three scenarios. [2]
  - (x) Produce a chart that shows the anticipated total net bank charges (split between interest and overdraft fees) for the year that Grace would have to pay under all three scenarios. [2]

### Marks available for spreadsheet model and checks:

Accurate completion of above modelling steps	[30]
Demonstration of good modelling technique and practice	[7]
Checks	[8]

[Sub total 45]

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

- purpose of the model
- data and assumptions used
- 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**

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

**Audit content**

<b>All steps clearly explained</b>	<b>[7]</b>
<b>Clear signposting throughout</b>	<b>[5]</b>
<b>Statement of assumptions made</b>	<b>[5]</b>
<b>All model steps accurately covered</b>	<b>[15]</b>

**[Sub total 55]**

**[Total 100]**

## Background

Grace is looking to open a bakery at the local railway station. The premises available to rent out were previously used as a bakery so Grace could begin trading immediately from 1 January 2018. The bakery premises will be rented for a 12-month period. Grace has asked your boss if you are able to model the cashflows and profit from the business over the first 12 months of trading.

The annual rent for the bakery is \$5,000, which is payable quarterly, in equal instalments, at the start of each quarter.

Grace has decided to sell four products – bread, cakes, sandwiches and pies. She expects the sale price and production costs for each product to be fixed for the year as shown in the table below, where one unit is one item of food (e.g. one cake equals one unit):

<i>Product</i>	<i>Sale price per unit</i>	<i>Production costs per unit</i>
<b>Loaf of Bread</b>	\$1.00	\$0.50
<b>Cake</b>	\$2.00	\$0.50
<b>Sandwich</b>	\$3.00	\$1.00
<b>Pie</b>	\$4.00	\$1.00

Grace expects, for any month, to pay for the production costs at the start of the month and to bank the revenue from selling the products at the end of the month.

Grace also expects to sell 1,000 units of food each month, split between the four types of product as follows:

- 25% of the total units sold each month will be bread.
- 25% of the total units sold each month will be cakes.
- The number of pies sold each month will vary depending on the season. In January and December when the weather is cold, 40% of the total units of food sold in these months is expected to be pies. In June and July, when the weather is warmer, 10% of the total sales in these months are expected to be pies. The weather is expected to get uniformly warmer each month between January and June, and uniformly colder each month between July and December. Grace expects the demand for pies between January and June to correspondingly reduce as it gets warmer, and correspondingly increase between July and December as it gets colder.
- The remaining units sold each month will be sandwiches.

Grace does not have any spare capital. She therefore requires a bank account which allows the business to go temporarily overdrawn (i.e. the bank account can have a negative balance). Grace has approached her local bank to enquire what interest rate would apply to the balance on the account.

The bank has advised her that if the bank balance is negative at the start of the month then interest at a rate of 5% per annum will apply to the balance at the start of the month. In addition a monthly overdraft fee of \$100 would be payable at the end of the month. There are no other overdraft fees payable. If the bank balance is positive at the start of the month,

the bank will pay interest at a rate of 3% per annum. Interest charged on a negative balance or paid on a positive balance is calculated on a monthly basis and deducted from or added to the bank balance at the end of each month.

Your boss has asked you to model the cashflows over the year, in particular the balance in the bank account. The bank balance at 1 January 2018 will be \$0. Grace intends to take a salary of \$1,000 each month, paid on the last day of the month.

There has recently been an announcement from the Revenue and Customs office (“RC”) about a major simplification to the country’s tax system. The RC has decided that from 1 January 2018 there will only be two types of tax imposed:

- a salary tax, calculated as 25% of an individual’s total salary over the tax year
- a profit tax, calculated as 40% of a company’s monthly income (I) less expenditure (E) over the year accumulated to the end of the tax year

RC have provided the following guidance in calculating the profit tax:

- The I-E cashflows are calculated for each month over the tax year.
- Each month’s net cashflows are accumulated to the end of the tax year using the prescribed accumulation rate of 10% per annum. For the purposes of the I-E tax calculation, the RC requires businesses to assume that all cashflows occur in the middle of each month.
- Bank interest incurred or earned and any overdraft fees should be excluded from the I-E cashflows.
- The tax year runs from 1 January to 31 December.
- Any tax due is paid at the end of the tax year.

### **Scenario 1**

Assuming that Grace takes a monthly salary of \$1,000 from the business, you have been asked to determine the following:

- the projected bank balance for the business, each month up to the end of the year, based on expected cashflows
- the total expected net bank charges paid over the course of the year (defined as interest earned – interest incurred – overdraft fees)
- Grace’s expected total tax bill (i.e. individual salary tax plus profit tax from the business on the “I-E” basis)

### **Scenario 2**

Grace would like to know the monthly salary she could take from the business such that the business bank balance at the end of the year is expected to be just enough to pay her total tax bill. She would also like to know the expected net bank fees for the year under this scenario.

### **Scenario 3**

Grace would like to know the monthly salary she could take from the business such that the accumulated value of the income less expenditure for the business, under the RC's rules, at the end of the tax year would be \$0. This would then mean that there would be no profit tax due for 2018. She would also like to know the expected net bank charges for the year under this scenario.

**END OF PAPER**