Subject CS1: Assignment Y1

2019 Examinations

The time allowed for this assignment is 1¾ hours.

Attempt all of the questions, as far as possible under exam conditions.

If you are having your assignment marked by ActEd, please follow these instructions carefully:

- *Download and open the Word document 'CS1 Assignment Y1 Answer Booklet 12345'. Follow the instructions provided in the template and enter your answers where indicated.*
- *In your submission include sufficient R code for the markers to work out how you arrived at your answers.*
- ***Begin your answer to each question on a new page. Only send ActEd one Word file (created using the template) when you have completed the assignment.***
- *When submitting your script, email your word file to ActEdMarking@bpp.com.*
- *Assignment marking is not included in the price of the course materials. Please purchase Series Y Marking or a Marking Voucher before submitting your script.*
- *We only accept the current version of assignments for marking, and so you can only submit this assignment in the sessions leading to the 2019 exams.*
- *We only accept Word files produced in Office 2007, 2010 or 2013 format. Submitted assignments will not be marked if any of the files are suspected to have been affected by a computer virus or to have been corrupted.*
- *You should aim to submit this script for marking by the recommended submission date. The recommended and deadline dates for submission of this assignment are listed on the summary page at the back of this pack and on our website at www.ActEd.co.uk.*
- *Scripts received after the deadline date will not be marked, unless you are using a Marking Voucher. It is your responsibility to ensure that scripts reach ActEd in good time. If you are using Marking Vouchers, then please make sure that your script reaches us by the Marking Voucher deadline date to give us enough time to mark and return the script before the exam.*
- *In addition to this paper, you should have available actuarial tables and an electronic calculator.*

Y1.1 In a particular portfolio of 1,000 life assurance policyholders, deaths are assumed to occur independently with a probability of 0.05.

(i) Calculate the median number of deaths. [4]

(ii) Calculate the probability that the number of deaths, D, lies between 45 and 59 inclusive:

(a) exactly

(b) using a Poisson approximation

(c) using a normal approximation. [16]

[Total 20]

Y1.2 (i) (a) Calculate 1,000 simulated values from a $U(0,1)$ distribution using set.seed(13).

(b) Hence, determine 1,000 simulations from the distribution which has cumulative distribution function:

$$F(x)=1-\frac{1}{1+x}, \quad x>0$$ [7]

(ii) Use your simulations from part (i)(b) to:

(a) plot a labelled graph of the empirical PDF of the simulations for the range $x\in(0,200)$

(b) calculate the empirical mean, standard deviation and coefficient of skewness and comment on the shape of the distribution. [13]

[Total 20]

Y1.3 A company that makes Gizmos™ is trying to ascertain the percentage of consumers who are aware of the existence of its product. A study is to be carried out in which a random sample of the population will be interviewed and asked whether or not they are aware of it.

(i) In a sample of 20 people, 10 had heard of Gizmos™. Determine the width of an exact 95% confidence interval for the underlying population proportion. [5]

(ii) Show exhaustively for a sample of size 20 that the greatest width of an exact binomial confidence interval occurs when half of the sample have heard of Gizmos™. [8]

[Total 13]

Y1.4 An insurer is measuring the inter-arrival times between notification of consecutive claims from a portfolio of policies with a low claim rate. The insurer believes that these inter-arrival times may have an exponential distribution with unknown parameter λ. A random sample gives the following time periods (in days) between consecutive claims:

14, 4, 3, 2, 3, 1, 5, 10, 4, 23

(i) Derive a 99% confidence interval for the exponential parameter λ using a non-parametric bootstrap and set.seed(17), based on a sample of 1,000 values. [10]

After extensive analysis it is decided that the inter-arrival times have an exponential distribution with parameter 0.145.

(ii) (a) Determine 1,000 simulated means from samples of size 10 from this exponential distribution using set.seed(19).

(b) Plot a histogram of the densities of these sample means.

(c) Use the results of part (ii)(a) to calculate the empirical probability that the sample mean is less than 5. [14]

A statistician points out that if $X \sim Exp(\lambda)$, then $\bar{X} \sim Gamma(n, n\lambda)$.

(iii) Plot the PDF of the appropriate gamma distribution on the histogram of part (ii)(b) and comment. [5]

(iv) Calculate the exact probability that the sample mean is less than 5 using this result and compare to part (ii)(c). [5]

(v) (a) Determine 1,000 simulated values from the appropriate gamma distribution using set.seed(21).

(b) Plot a Q-Q plot of the sample means from part (ii)(a) and the simulations from part (v)(a) and comment on the result. [13]

[Total 47]

END OF PAPER

For the session leading to the April 2019 exams – CS1B, CS2B, CM1B & CM2B Subjects

Marking vouchers

Subjects	Assignments
CS1B	6 March 2019
CS2B, CM1B	13 March 2019
CM2B	20 March 2019

Series Y Assignments

Subjects	Assignment	Recommended submission date	Final deadline date
CS1B	**Y1**	**2 January 2019**	30 January 2019
CS2B, CM1B		**9 January 2019**	6 February 2019
CM2B		**16 January 2019**	13 February 2019
CS1B	**Y2**	**13 February 2019**	6 March 2019
CS2B, CM1B		**20 February 2019**	13 March 2019
CM2B		**27 February 2019**	20 March 2019

We encourage you to work to the recommended submission dates where possible.

If you submit your assignment on the final deadline date you are likely to receive your script back less than a week before your exam.

For the session leading to the September 2019 exams – CS1B, CS2B, CM1B & CM2B Subjects

Marking vouchers

Subjects	Assignments
CS1B, CS2B	21 August 2019
CM1B, CM2B	28 August 2019

Series Y Assignments

Subjects	Assignment	Recommended submission date	Final deadline date
CS2B	**Y1**	**26 June 2019**	24 July 2019
CS1B		**19 June 2019**	31 July 2019
CM1B		**3 July 2019**	31 July 2019
CM2B		**26 June 2019**	7 August 2019
CS2B	**Y2**	**31 July 2019**	14 August 2019
CS1B		**31 July 2019**	21 August 2019
CM1B		**7 August 2019**	21 August 2019
CM2B		**7 August 2019**	28 August 2019

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