# Maths and Stats assumed knowledge – initial assessment

We have written a short test to help students assess whether they would benefit from revising the assumed knowledge for the actuarial exams. There are 25 questions, which are typical of problems that will be encountered in the exams. The test should take you about 90 minutes to complete. The questions are split into two sections. Questions 1 to 23 are based on the maths you will encounter in subjects CS1 and CM1 (most students will start with one of these subjects in their first sitting). Questions 24 and 25 are based on the maths required for the later Core Principles subjects.

You should attempt the test without reference to a textbook.

***Questions based on the maths required for Subjects CS1 and CM1***

**1.** Simplify $3\ln(1+i)+\ln(1+i)^5$ .

**2.** Determine $\dfrac{d}{dx}\left(\dfrac{1-(1+x)^{-4}}{\ln(1+x)}\right)$.

**3.** Rewrite $|2-4x|<3$ without the modulus sign.

**4.** Solve the equation $2x^2-4x+1=0$ .

**5.** State the formula for the sum to $n$ terms of a geometric progression.

**6.** Determine $\dfrac{\partial f}{\partial y}$ , where $f=(x+2y)^2 e^y \ln xy$ .

**7.** The quantities $\alpha,\beta,\gamma,\phi,\psi$ are related by the equation $\psi=\dfrac{\beta+\phi^\gamma}{\alpha}$. Given that $\alpha=2.3323$, $\beta=0.18224$, $\gamma=2.233$ and $\psi=0.0789879$ , calculate the value of $\phi$, quoting your answer correct to 4 significant figures.

**8.** Solve the inequality $x^2-x-6<0$ .

**9.** Determine $\displaystyle\int xe^{3x}\,dx$ .

**10.** Evaluate $\displaystyle\int_{-1}^{1}\dfrac{4+3x}{5+4x}\,dx$ .

**11.** Let $g(x)=e^x-2x-1$. The nontrivial root of the equation $g(x)=0$ is denoted by $\xi$. By applying linear interpolation to the values of $g(1)$ and $g(2)$, find an approximate value of $\xi$, quoting your answer to 3 significant figures.

**12.** Evaluate $\displaystyle\int_{y=1}^{20}\int_{x=2}^{10} 3x+2y\,dxdy$ .

**13.** Calculate the value of $\lambda$ which maximises $\ln \dfrac{e^{-\lambda n} \lambda^{\sum\limits_{i=1}^{n} x_i}}{\prod\limits_{i=1}^{n} x_i}$.

**14.** Simplify $\prod\limits_{i=1}^{n} \lambda e^{-\lambda x_i}$.

**15.** The delay (in minutes) of 30 late-running trains is shown below.

| Time, $t$, in minutes | Cumulative frequency |
|:---:|:---:|
| $t < 10$ | 6 |
| $t < 30$ | 11 |
| $t < 60$ | 23 |
| $t < 90$ | 27 |
| $t < 150$ | 30 |

Estimate the sample mean delay.

**16.** Four male and two female candidates are waiting in a room to be called for an interview. The candidates will be called one after the other, in a random order. Calculate the probability that the next two candidates called for interview are both male.

**17.** An insurance company is using last year's data to analyse its claims on both contents insurance and buildings insurance. The sample mean and standard deviation of the claims on 1,021 contents policies were £8,673 and £2,400, respectively. The sample mean and standard deviation of the claims on 627 buildings policies were £19,437 and £5,025, respectively. Calculate the sample standard deviation of all 1,648 policies.

**18.** In a certain large population, 54% of adults are female. When asked their views on a given proposal, 20% of females said they were in favour, 55% of females said they were not in favour, and the remainder said they were undecided. The corresponding percentages for males are 23% in favour, 65% not in favour, and the rest undecided. An adult is randomly selected from this population. Calculate the probability that this person is female, given that the person is undecided.

**19.** The probability density function of a random variable $X$ is given by:

$$f(x) = k(1 - x^2) \qquad -1 \le x \le 1$$

Determine the value of $k$.

**20.** The probability density function of a random variable $X$ is given by:

$$f(x) = \frac{1}{4}(3-x) \qquad 0 \leq x \leq 2$$

Calculate the median of $X$.

**21.** A random variable $X$ has $E[X] = 2$ and PDF:

$$f(x) = \frac{2}{x^3} \qquad x > 1$$

Calculate the value of $E\left[\dfrac{1}{X}\right]$.

**22.** A discrete random variable $X$ has the following probability function:

| $x$ | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| $P(X = x)$ | 0.25 | 0.3 | 0.25 | 0.2 |

Calculate $var[3X - 2]$.

**23.** The number of claims, $X$, arise on a policy according to the following probability distribution:

| $x$ | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| $P(X = x)$ | 0.4 | 0.35 | 0.2 | 0.05 |

Calculate the coefficient of skewness.

*Questions based on the maths required for the later Core Principles subjects*

**24.** State the condition that two vectors, **a** and **b**, are perpendicular.

**25.** Determine the inverse and the eigenvalues of the matrix $\mathbf{M} = \begin{pmatrix} 5 & 3 \\ 4 & 9 \end{pmatrix}$.

*If you found these questions difficult, you will find the Maths and Stats for Actuarial Studies course useful.*
*For full details of the course see www.ActEd.co.uk.*

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