Syllabus

Cambridge O Level Statistics
Syllabus code 4040
For examination in November 2013

UNIVERSITY *of* **CAMBRIDGE**
International Examinations

Contents

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1. Introduction

1.1 Why choose Cambridge?

University of Cambridge International Examinations (CIE) is the world's largest provider of international qualifications. Around 1.5 million students from 150 countries enter Cambridge examinations every year. What makes educators around the world choose Cambridge?

Developed for an international audience

International O Levels have been designed specially for an international audience and are sensitive to the needs of different countries. These qualifications are designed for students whose first language may not be English and this is acknowledged throughout the examination process. The curriculum also allows teaching to be placed in a localised context, making it relevant in varying regions.

Recognition

Cambridge O Levels are internationally recognised by schools, universities and employers as equivalent to UK GCSE. They are excellent preparation for A/AS Level, the Advanced International Certificate of Education (AICE), US Advanced Placement Programme and the International Baccalaureate (IB) Diploma. CIE is accredited by the UK Government regulator, the Office of the Qualifications and Examinations Regulator (Ofqual). Learn more at **www.cie.org.uk/recognition**.

Support

CIE provides a world-class support service for teachers and exams officers. We offer a wide range of teacher materials to Centres, plus teacher training (online and face-to-face) and student support materials. Exams officers can trust in reliable, efficient administration of exams entry and excellent, personal support from CIE Customer Services. Learn more at **www.cie.org.uk/teachers**.

Excellence in education

Cambridge qualifications develop successful students. They build not only understanding and knowledge required for progression, but also learning and thinking skills that help students become independent learners and equip them for life.

Not-for-profit, part of the University of Cambridge

CIE is part of Cambridge Assessment, a not-for-profit organisation and part of the University of Cambridge. The needs of teachers and learners are at the core of what we do. CIE invests constantly in improving its qualifications and services. We draw upon education research in developing our qualifications.

1. Introduction

1.2 Why choose Cambridge O Level Statistics?

International O Levels are established qualifications that keep pace with educational developments and trends. The International O Level curriculum places emphasis on broad and balanced study across a wide range of subject areas. The curriculum is structured so that candidates attain both practical skills and theoretical knowledge.

Cambridge O Level Statistics is recognised by universities and employers throughout the world as proof of statistical knowledge and understanding. Successful Cambridge O Level Statistics candidates acquire knowledge of basic statistical ideas, methods and terminology. Study of the content of the syllabus enables candidates to:

- Represent and use statistical data in graphical, diagrammatic and tabular forms.
- Interpret statistical statements, calculations and diagrams.
- Perform statistical calculations accurately.
- Acquire knowledge of elementary ideas in probability.

Cambridge O Level Statistics provides a suitable foundation for further study in the subject, as well as developing concepts which are relevant in a wide range of other subjects.

1.3 How can I find out more?

If you are already a Cambridge Centre

You can make entries for this qualification through your usual channels, e.g. your regional representative, the British Council or CIE Direct. If you have any queries, please contact us at **international@cie.org.uk**.

If you are not a Cambridge Centre

You can find out how your organisation can become a Cambridge Centre. Email either your local British Council representative or CIE at **international@cie.org.uk**. Learn more about the benefits of becoming a Cambridge Centre at **www.cie.org.uk**.

2. Assessment at a glance

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All candidates take both Paper 1 and Paper 2.

Paper 1	2 hours 15 minutes
A written paper of two sections. **Section A:** Six compulsory short questions worth 36 marks **Section B:** Candidates choose four out of five longer questions worth 64 marks.	

and

Paper 2	2 hours 15 minutes
A written paper of two sections. **Section A:** Six compulsory short questions worth 36 marks **Section B:** Candidates choose four out of five longer questions worth 64 marks.	

A high standard of accuracy will be expected in calculations and in the drawing of diagrams and graphs. All working must be clearly shown. **The use of an electronic calculator is expected in both papers.**

Past papers are available from CIE.

Electronic Calculators
1. At all centres, the use of silent electronic calculators is expected.
2. The General Regulations concerning the use of electronic calculators are contained in the *Handbook for Centres*.

Mathematical Instruments
Apart from the usual mathematical instruments, candidates may use flexicurves in this examination.

Mathematical Notation
Please see the list of mathematical notation at the end of this booklet.

Examiners' Reports (SR(I) booklets)
Reports on the November examinations are distributed to International Centres in April/May.

2. Assessment at a glance

Availability

This syllabus is examined in the October/November examination session.

This syllabus is available to private candidates.

International O levels are available to Centres in Administrative Zones 3, 4 and 5. Centres in Administrative Zones 1, 2 or 6 wishing to enter candidates for International O Level examinations should contact CIE Customer Services.

Combining this with other syllabuses

Candidates can combine this syllabus in an examination session with any other CIE syllabus, except:

- syllabuses with the same title at the same level

Please note that IGCSE, Cambridge International Level 1/Level 2 Certificates and O Level syllabuses are at the same level.

3. Syllabus aims and objectives

3.1 Aims

The course should enable students to:

- appreciate that much of the information encountered in a wide variety of contexts in everyday life has a statistical base;
- recognise the suitability of this information for statistical analysis;
- appreciate the extent of the accuracy of this information;
- acquire an understanding of the elementary concepts of statistics and probability which are useful and relevant for carrying out such analysis;
- apply appropriate methods based on these concepts to numerical information;
- draw appropriate conclusions from the results of the application of statistical methods;
- interpret both primary statistical information and the conclusions of statistical analysis;
- be aware of the limitations and levels of accuracy of interpretations and conclusions, and their relevance in an everyday societal context.

3.2 Assessment objectives

The examination tests the ability of candidates to:

- define/describe elementary statistical concepts and procedures;
- present data in a suitable form for analysis;
- justify the use of a particular method in a given situation;
- solve statistical and probability problems numerically;
- perform relevant statistical calculations accurately;
- communicate conclusions and interpretations.

4. Curriculum content

Syllabus	Notes
1. General ideas of sampling and surveys. Bias: how it arises and is avoided.	Including knowledge of the terms: random sample, stratified random sample, quota sample, systematic sample.
2. The nature of a variable.	Including knowledge of the terms: discrete, continuous, quantitative and qualitative.
3. Classification, tabulation and interpretation of data. Pictorial representation of data; the purpose and use of various forms, their advantages and disadvantages.	Including pictograms, pie charts, bar charts, sectional and percentage bar charts, dual bar charts, change charts.
4. Frequency distributions; frequency polygons and histograms.	Including class boundaries and mid-points, class intervals.
5. Cumulative frequency distributions, curves (ogives) and polygons.	
6. Measures of central tendency and their appropriate use; mode and modal class, median and mean. Measures of dispersion and their appropriate use; range, interquartile range, variance and standard deviation.	Calculation of the mean, the variance and the standard deviation from a set of numbers, a frequency distribution and a grouped frequency distribution, including the use of an assumed mean. Estimation of the median, quartiles and percentiles from a set of numbers, a cumulative frequency curve or polygon and by linear interpolation from a cumulative frequency table. The effect on mean and standard deviation of adding a constant to each observation and of multiplying each observation by a constant. Linear transformation of data to a given mean and standard deviation.
7. Index numbers, composite index numbers, price relatives, crude and standardised rates.	

www.theallpapers.com

4. Curriculum content

8. Moving averages.	Including knowledge of the terms: time series, trend, seasonal variation, cyclic variation. Centering will be expected, where appropriate.
9. Scatter diagrams; lines of best fit.	Including the method of semi-averages for fitting a straight line; the derivation of the equation of the fitted straight line in the form $y = mx + c$.
10. Elementary ideas of probability.	Including the treatment of mutually exclusive and independent events.
11. Simple probability and frequency distributions for a discrete variable. Expectation.	Including expected profit and loss in simple games; idea of a fair game.

5. Mathematical notation

The list which follows summarises the notation used in the CIE's Mathematics examinations. Although primarily directed towards Advanced/HSC (Principal) level, the list also applies, where relevant, to examinations at O Level/S.C.

1. Set Notation

$\in$	is an element of
$\notin$	is not an element of
$\{x_1, x_2, \ldots\}$	the set with elements $x_1, x_2, \ldots$
$\{x: \ldots\}$	the set of all x such that…
$n\,(A)$	the number of elements in set A
$\varnothing$	the empty set
$\mathscr{E}$	universal set
A'	the complement of the set A
$\mathbb{N}$	the set of positive integers, $\{1, 2, 3, \ldots\}$
$\mathbb{Z}$	the set of integers $\{0, \pm 1, \pm 2, \pm 3, \ldots\}$
$\mathbb{Z}^+$	the set of positive integers $\{1, 2, 3, \ldots\}$
$\mathbb{Z}_n$	the set of integers modulo n, $\{0, 1, 2, \ldots, n-1\}$
$\mathbb{Q}$	the set of rational numbers
$\mathbb{Q}^+$	the set of positive rational numbers, $\{x \in \mathbb{Q}: x > 0\}$
$\mathbb{Q}_0^+$	the set of positive rational numbers and zero, $\{x \in \mathbb{Q}: x \geqslant 0\}$
$\mathbb{R}$	the set of real numbers
$\mathbb{R}^+$	the set of positive real numbers $\{x \in \mathbb{R}: x > 0\}$
$\mathbb{R}_0^+$	the set of positive real numbers and zero $\{x \in \mathbb{R}: x \geqslant 0\}$
$\mathbb{R}^n$	the real n-tuples
$\mathbb{C}$	the set of complex numbers
$\subseteq$	is a subset of
$\subset$	is a proper subset of
$\nsubseteq$	is not a subset of
$\not\subset$	is not a proper subset of
$\cup$	union
$\cap$	intersection
$[a, b]$	the closed interval $\{x \in \mathbb{R}: a \leqslant x \leqslant b\}$
$[a, b)$	the interval $\{x \in \mathbb{R}: a \leqslant x < b\}$
$(a, b]$	the interval $\{x \in \mathbb{R}: a < x \leqslant b\}$
(a, b)	the open interval $\{x \in \mathbb{R}: a < x < b\}$
yRx	y is related to x by the relation R
$y \sim x$	y is equivalent to x, in the context of some equivalence relation

5. Mathematical notation

2. Miscellaneous Symbols

$=$	is equal to
$\neq$	is not equal to
$\equiv$	is identical to or is congruent to
$\approx$	is approximately equal to
$\cong$	is isomorphic to
$\propto$	is proportional to
$<;\ \ll$	is less than, is much less than
$\leqslant,\ \not>$	is less than or equal to, is not greater than
$>;\ \gg$	is greater than, is much greater than
$\geqslant,\ \not<$	is greater than or equal to, is not less than
∞	infinity

3. Operations

$a + b$	a plus b
$a - b$	a minus b
$a \times b,\ ab,\ a.b$	a multiplied by b
$a \div b,\ \dfrac{a}{b},\ a/b$	a divided by b
$a : b$	the ratio of a to b
$\displaystyle\sum_{i=1}^{n} a_i$	$a_1 + a_2 + \ldots + a_n$
$\sqrt{a}$	the positive square root of the real number a
$\lvert a \rvert$	the modulus of the real number a
$n!$	n factorial for $n \in \mathbb{N}$ ($0! = 1$)
$\dbinom{n}{r}$	the binomial coefficient $\dfrac{n!}{r!(n-r)!}$, for $n,\ r \in \mathbb{N},\ 0 \leqslant r \leqslant n$
	$\dfrac{n(n-1)\ldots(n-r+1)}{r!}$, for $n \in \mathbb{Q},\ r \in \mathbb{N}$

5. Mathematical notation

4. Functions

f	function f
f (x)	the value of the function f at x
f : $A \rightarrow B$	f is a function under which each element of set A has an image in set B
f : $x \mapsto y$	the function f maps the element x to the element y
f $^{-1}$	the inverse of the function f
g $\circ$ f, gf	the composite function of f and g which is defined by $(g \circ f)(x)$ or gf $(x) = g(f(x))$
$\lim_{x \to a}$ f(x)	the limit of f (x) as x tends to a
$\Delta x; \delta x$	an increment of x
$\dfrac{dy}{dx}$	the derivative of y with respect to x
$\dfrac{d^n y}{dx^n}$	the nth derivative of y with respect to x
f $'(x)$, f $''(x)$, …, f$^{(n)}(x)$	the first, second, …, nth derivatives of f(x) with respect to x
$\displaystyle\int y\,dx$	indefinite integral of y with respect to x
$\displaystyle\int_a^b y\,dx$	the definite integral of y with respect to x for values of x between a and b
$\dfrac{\partial y}{\partial x}$	the partial derivative of y with respect to x
$\dot{x}, \ddot{x}, \ldots$	the first, second, … derivatives of x with respect to time

5. Exponential and Logarithmic Functions

e	base of natural logarithms
e^x, exp x	exponential function of x
$\log_a x$	logarithm to the base a of x
ln x	natural logarithm of x
lg x	logarithm of x to base 10

6. Circular and Hyperbolic Functions and Relations

sin, cos, tan, cosec, sec, cot }	the circular functions
sin^{-1}, cos^{-1}, tan^{-1}, cosec^{-1}, sec^{-1}, cot^{-1} }	the inverse circular relations
sinh, cosh, tanh, cosech, sech, coth }	the hyperbolic functions

$\left.\begin{array}{l}\sinh^{-1},\ \cosh^{-1},\ \tanh^{-1},\\ \operatorname{cosech}^{-1},\ \operatorname{sech}^{-1},\ \coth^{-1}\end{array}\right\}$ the inverse hyperbolic relations

7. Complex Numbers

i	square root of -1
z	a complex number, $z = x + iy$
	$\quad\quad = r(\cos\theta + i\sin\theta),\ r \in \mathbb{R}_0^+$
	$\quad\quad = re^{i\theta},\ r \in \mathbb{R}_0^+$
$\operatorname{Re} z$	the real part of z, $\operatorname{Re}(x + iy) = x$
$\operatorname{Im} z$	the imaginary part of z, $\operatorname{Im}(x + iy) = y$
$|z|$	the modulus of z, $|x + iy| = \sqrt{(x^2 + y^2)}$, $|r(\cos\theta + i\sin\theta)| = r$
$\arg z$	the argument of z, $\arg(r(\cos\theta + i\sin\theta)) = \theta$, $-\pi < \theta \leqslant \pi$
z^*	the complex conjugate of z, $(x + iy)^* = x - iy$

8. Matrices

$\mathbf{M}$	a matrix $\mathbf{M}$
$\mathbf{M}^{-1}$	the inverse of the square matrix $\mathbf{M}$
$\mathbf{M}^{T}$	the transpose of the matrix $\mathbf{M}$
$\det \mathbf{M}$	the determinant of the square matrix $\mathbf{M}$

9. Vectors

$\mathbf{a}$	the vector $\mathbf{a}$
$\overrightarrow{AB}$	the vector represented in magnitude and direction by the directed line segment AB
$\hat{\mathbf{a}}$	a unit vector in the direction of the vector $\mathbf{a}$
$\mathbf{i}, \mathbf{j}, \mathbf{k}$	unit vectors in the directions of the cartesian coordinate axes
$|\mathbf{a}|$	the magnitude of $\mathbf{a}$
$|\overrightarrow{AB}|$	the magnitude of $\overrightarrow{AB}$
$\mathbf{a} \cdot \mathbf{b}$	the scalar product of $\mathbf{a}$ and $\mathbf{b}$
$\mathbf{a} \times \mathbf{b}$	the vector product of $\mathbf{a}$ and $\mathbf{b}$

10. Probability and Statistics

A, B, C etc.	events
$A \cup B$	union of events A and B
$A \cap B$	intersection of the events A and B
$P(A)$	probability of the event A
A'	complement of the event A, the event 'not A'
$P(A|B)$	probability of the event A given the event B
X, Y, R, etc.	random variables
x, y, r, etc.	values of the random variables X, Y, R, etc.
$x_1, x_2, \ldots$	observations
$f_1, f_2, \ldots$	frequencies with which the observations $x_1, x_2, \ldots$ occur

5. Mathematical notation

$p(x)$	the value of the probability function $P(X = x)$ of the discrete random variable X
$p_1, p_2, \ldots$	probabilities of the values $x_1, x_2, \ldots$ of the discrete random variable X
$f(x), g(x), \ldots$	the value of the probability density function of the continuous random variable X
$F(x), G(x), \ldots$	the value of the (cumulative) distribution function $P(X \leqslant x)$ of the random variable X
$E(X)$	expectation of the random variable X
$E[g(X)]$	expectation of $g(X)$
$Var(X)$	variance of the random variable X
$G(t)$	the value of the probability generating function for a random variable which takes integer values
$B(n, p)$	binomial distribution, parameters n and p
$N(\mu, \sigma^2)$	normal distribution, mean μ and variance σ^2
μ	population mean
σ^2	population variance
σ	population standard deviation
$\bar{x}$	sample mean
s^2	unbiased estimate of population variance from a sample, $$s^2 = \frac{1}{n-1}\sum(x - \bar{x})^2$$
ϕ	probability density function of the standardised normal variable with distribution $N(0, 1)$
Φ	corresponding cumulative distribution function
ρ	linear product-moment correlation coefficient for a population
r	linear product-moment correlation coefficient for a sample
$Cov(X, Y)$	covariance of X and Y

6. Resource list

These titles represent some of the texts available in the UK at the time of printing this booklet. Teachers are encouraged to choose texts for class use which they feel will be of interest to their candidates and will support their own teaching style. ISBN numbers are provided wherever possible.

Suggested Books

Author	Title	Date	Publisher	ISBN Number
Caswell	*Success in Statistics*	1994	John Murray	019572029
Chalmers	*O Level Statistics*	2003	Voila Publishers	9991255907
Clegg	*Simple Statistics*	1983	Cambridge University Press	0521288029
Hartley	*Statistics Book 1*	1998	Impart Books	8120203089
Plews	*Introductory Statistics*	1979	Heinemann	0435537504
Walker, McLean and Matthew	*Statistics – a first course*	1993	Hodder and Stoughton Educational	0340552468

Resources are also listed on CIE's public website at **www.cie.org.uk**. Please visit this site on a regular basis as the Resource lists are updated through the year.

Access to teachers' email discussion groups, suggested schemes of work and regularly updated resource lists may be found on the CIE Teacher Support website at **http://teachers.cie.org.uk**. This website is available to teachers at registered CIE Centres.

7. Additional information

7.1 Guided learning hours

O Level syllabuses are designed on the assumption that candidates have about 130 guided learning hours per subject over the duration of the course. ('Guided learning hours' include direct teaching and any other supervised or directed study time. They do not include private study by the candidate.)

However, this figure is for guidance only, and the number of hours required may vary according to local curricular practice and the candidates' prior experience of the subject.

7.2 Recommended prior learning

Candidates beginning this course are not expected to have studied Statistics previously.

7.3 Progression

O Level Certificates are general qualifications that enable candidates to progress either directly to employment, or to proceed to further qualifications.
Candidates who are awarded grades C to A* in O Level Statistics are well prepared to follow courses leading to AS and A Level Statistics, or the equivalent.

7.4 Component codes

Because of local variations, in some cases component codes will be different in instructions about making entries for examinations and timetables from those printed in this syllabus, but the component names will be unchanged to make identification straightforward.

7.5 Grading and reporting

Ordinary Level (O Level) results are shown by one of the grades A*, A, B, C, D or E indicating the standard achieved, Grade A* being the highest and Grade E the lowest. 'Ungraded' indicates that the candidate's performance fell short of the standard required for Grade E. 'Ungraded' will be reported on the statement of results but not on the certificate.

Percentage uniform marks are also provided on each candidate's statement of results to supplement their grade for a syllabus. They are determined in this way:

7. Additional information

- A candidate who obtains…

  … the minimum mark necessary for a Grade A* obtains a percentage uniform mark of 90%.

  … the minimum mark necessary for a Grade A obtains a percentage uniform mark of 80%.

  … the minimum mark necessary for a Grade B obtains a percentage uniform mark of 70%.

  … the minimum mark necessary for a Grade C obtains a percentage uniform mark of 60%.

  … the minimum mark necessary for a Grade D obtains a percentage uniform mark of 50%.

  … the minimum mark necessary for a Grade E obtains a percentage uniform mark of 40%.

  … no marks receives a percentage uniform mark of 0%.

Candidates whose mark is none of the above receive a percentage mark in between those stated according to the position of their mark in relation to the grade 'thresholds' (i.e. the minimum mark for obtaining a grade). For example, a candidate whose mark is halfway between the minimum for a Grade C and the minimum for a Grade D (and whose grade is therefore D) receives a percentage uniform mark of 55%.

The uniform percentage mark is stated at syllabus level only. It is not the same as the 'raw' mark obtained by the candidate, since it depends on the position of the grade thresholds (which may vary from one session to another and from one subject to another) and it has been turned into a percentage.

7.6 Resources

Copies of syllabuses, the most recent question papers and Principal Examiners' reports for teachers are available on the Syllabus and Support Materials CD-ROM, which is sent to all CIE Centres.

Resources are also listed on CIE's public website at **www.cie.org.uk**. Please visit this site on a regular basis as the Resource lists are updated through the year.

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