LOCUS EDUCATION · QCE MATHEMATICAL METHODS UNITS 3 AND 4

Methods *Masterclass.*

Wednesday 11 November, 3 to 6:15pm
UQ St Lucia 24-S304 and on Zoom

Paper 1 (tech-free) Friday 13 Nov, AM · Paper 2 (tech-active) Friday 13 Nov, PM

Follow us on Instagram @locustutoring

2

days to the exam

What you asked us for

From the Methods RSVPs. Probability, stats and complex unfamiliar won by a mile.

Anything you'd like us to do?

Cover probability and stats as well as hard complex unfamiliar exam questions

Anything you'd like us to do?

PROBABILITY I BEGGG and how to tech-free, im lowk cooked

Anything you'd like us to do?

How to approach CU questions for methods

Anything you'd like us to do?

Sampling proportion and graphing derivatives, logs and exponentials for methods

Anything you'd like us to do?

Predicted or likely exam questions/topics for this coming external

Anything you'd like us to do?

"Evaluate the reasonableness" type questions and what they are asking for

Anything you'd like us to do?

Complex unfamiliar for methods and also normal distribution and harder derivation questions

Anything you'd like us to do?

Can you go over those integration particle questions

Anything you'd like us to do?

Practice questions + mistakes to look out for

...and some other things you asked for

We read every single one.

Anything you'd like us to do?

What is the mathematically correct caffeine intake to pull an all nighter studying methods

Anything you'd like us to do?

Free food

Anything you'd like us to do?

Snacks/light refreshments if the budget permits

Anything you'd like us to do?

Make me not cooked

Anything you'd like us to do?

save my methods grade

Anything you'd like us to do?

Help me get a 40/50 in methods

Anything you'd like us to do?

Not advertise ur tutoring program for too long, we have exams to study for guys

Anything you'd like us to do?

Learn how to get 100

Anything you'd like us to do?

Grind

You told us after Physics. Here's what we're trying.

From the Physics feedback forms. Keep telling us at the breaks.

“Zoom couldn't see the working”

All live working is on the iPad and shared to Zoom. No paper under the projector.

“Zoom chat was chaos”

Chat is off during questions. We open it for questions at the end of each block.

“Hard to hear some tutors”

Every tutor speaks into the mic, and we check the Zoom audio at the start.

“Too fast, give us time to read”

Each question has a solo time on the slide. You get it before we start working.

“Run through the content first”

Every block opens with formulas, traps and key ideas before any question.

“Stay on time”

Timetable is fixed. If a block runs over, we skip to the next block, not rush it.

“Zoom hit 300”

YouTube live is the overflow if Zoom fills.

“Harder, more QCAA-style questions”

Most questions are single-prompt like QCAA writes them, with Level 3 CU in every block.

The plan for today

3:00	Welcome and how today runs		Rishabh	
3:05	**Exponentials, logs and derivatives**		Rishabh	**4 questions**
3:30	**Applications of differentiation**		Julian	**4 questions**
4:00	Break / Blooket			
4:10	**Integration**		Senula	**3 questions**
4:35	**Trigonometry: triangles and 3D**		Julian	**4 questions**
5:05	**Discrete probability and binomial**	MOST REQUESTED	Rishabh	**3 questions**
5:30	Break			
5:40	**Continuous random variables and the normal**		Senula + Julian	**3 questions**
6:00	**Sampling, confidence intervals and complex unfamiliar**	EXAM FOCUS	Senula + Rishabh	**3 questions**
6:25	You're ready. Questions and close		Rishabh	

How every question runs

1

Try it alone

About half the slot. Use the blank space in your workbook. Write the set-up before you calculate.

2

Compare

Turn to the person next to you (or the Zoom chat). Where did your answers split?

3

Watch it live

A tutor works it on the screen, marking where each mark comes from.

4

Fix one thing

Circle the step you missed. That is what you revise tonight.

Level 1 simple familiar **Level 2** complex familiar **Level 3** complex unfamiliar

BLOCK 1 OF 7 · 3:05 TO 3:30 · UNIT 3

Exponentials, logs and derivatives.

Rishabh | key ideas, then 4 questions

Exponentials, logs, derivatives: formulas and traps

Know which one to grab. Most of these are in the QCAA formula book.

Log laws

$$\log(ab) = \log(a) + \log(b)$$

$$\log\left(\frac{a}{b}\right) = \log(a) - \log(b)$$

$$\log(a^n) = n\log(a)$$

Index form

$$\log_a(y) = x \iff a^x = y$$

Common mistakes

- ✗ Writing log(a + b) = log a + log b
- ✗ Forgetting to reject $u = 2^x \leq 0$
- ✗ Not checking log answers by substitution (QCAA 2025 flagged this)
- ✗ Dropping the inner derivative in the chain rule
- ✗ Calculator in degrees for calculus questions

Exponentials, logs, derivatives: formulas and traps

Know which one to grab. Most of these are in the QCAA formula book.

Exponential

$$\frac{d}{dx}e^{kx} = ke^{kx}$$

Log

$$\frac{d}{dx}\ln\left(f(x)\right) = \frac{f'(x)}{f(x)}$$

Product

$$(uv)' = u'v + uv'$$

Chain

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$

Common mistakes

- ✗ Writing log(a + b) = log a + log b
- ✗ Forgetting to reject $u = 2^x \leq 0$
- ✗ Not checking log answers by substitution (QCAA 2025 flagged this)
- ✗ Dropping the inner derivative in the chain rule
- ✗ Calculator in degrees for calculus questions

Exponential and log equations: the two moves

Most tech-free exponential questions are one of these.

- **Hidden quadratic**

  $a^{2x} = (a^x)^2$. Let $u = a^x$, factorise, then reject $u \leq 0$.

- **Collapse the logs:** Use log laws until there is ONE log each side, then go to index form.

  $$\log_2(x) + \log_2(x-2) = 3 \;\Rightarrow\; \log_2\big(x(x-2)\big) = 3 \;\Rightarrow\; x(x-2) = 8$$

- **Check every answer:** Substitute back. Any log of a zero or negative number means reject.

  $$x = 4, -2 \;\Rightarrow\; \log_2(-2) \text{ undefined} \;\Rightarrow\; \text{reject } x = -2, \text{ keep } x = 4$$

QUESTION

1

Level 1

3 marks

Tech-free

Solve: 4 min

WORKBOOK

Page 4

UP NEXT

Q2 Logs that lead to a quadratic

Hidden quadratic

Solve the equation below for x.

$$4^x - 3 \cdot 2^{x+1} + 8 = 0 \qquad [3]$$

2^2 2^1

$(2^2)^x - 3 \times 2^{x+1} + 8 = 0$

2^{2x} $3 \times 2 \times 2^x + 8 = 0$

$(2^x)^2 - 6 \times 2^x + 8 = 0$

$u = 2^x$

$u^2 - 6u + 8 = 0$

$(u-4)(u-2) = 0$

NFL

$u = 4, 2$

$2^x = 4 \quad x = 2$

$2^x = 2$

$x = 1$

Workbook page 4. Try it on your own first.

WORKING

1

Level 1

3 marks

Tech-free

Solo: 4 min

WORKBOOK

Page 4

UP NEXT

Q2 Logs that lead to a quadratic

Hidden quadratic: working

Tutor works this one live. 3 marks

QUESTION

2

Level 2

4 marks

Tech-free

Solo: 6 min

WORKBOOK

Page 5

UP NEXT

Q3 Derivative toolkit

Logs that lead to a quadratic

Consider the equation $\log_3(x+2) + \log_3(x-4) = 3$.

Solve the equation for x. Justify the rejection of any solution and verify your answer. [4]

$\log_3(x+2) + \log_3(x-4) = 3$

$\log_3((x+2)(x-4)) = 3$

$3^3 = (x+2)(x-4)$

$27 = (x+2)(x-4)$

$27 = x^2 - 2x - 8$

$0 = x^2 - 2x - 35$

$0 = (x-7)(x+5)$

Workbook page 5. Try it on your own first.

WORKING

2

Level 2

4 marks

Tech-free

Solo: 6 min

WORKBOOK

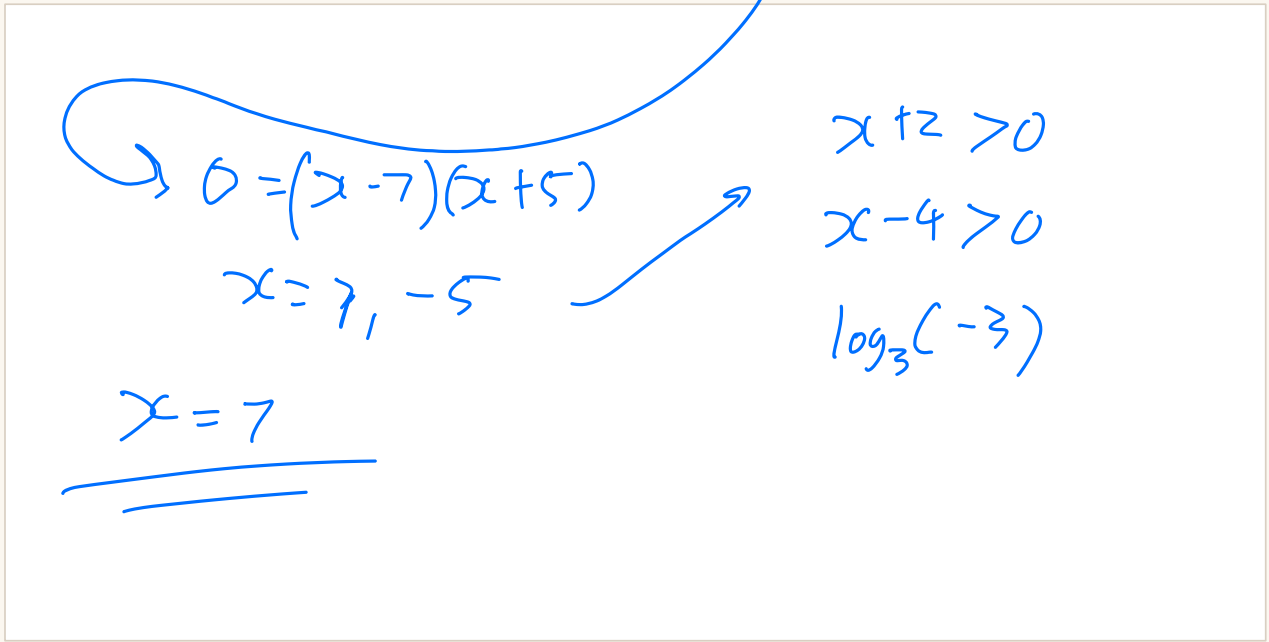
Page 5

UP NEXT

Q3 Derivative toolkit

Logs that lead to a quadratic: working

Tutor works this one live. 4 marks



Which derivative rule?

Ask: is it a product, a fraction, or a function inside a function?

Product: two things multiplied

$$x^2 e^{3x}, \quad x \sin x, \quad e^x \ln x$$

Chain: one thing inside another

$$\sin^2(3x), \quad e^{x^2}, \quad \ln\left(x^2 + 4\right)$$

Quotient: a fraction of functions

$$\frac{\ln x}{x}, \quad \frac{\sin x}{x}.$$ Or rewrite as a product.

QUESTION

3

Level 1

2 marks

Tech-free

Solo: 3 min

WORKBOOK

Page 6

UP NEXT

Q4 Drug concentration model

Derivative toolkit

Let $y = x^2 e^{3x}$.

Determine $\frac{dy}{dx}$. [2]

$y' = u'v + v'u$

$u = x^2 \qquad u' = 2x$

$v = e^{3x} \qquad v' = 3e^{3x}$

$\frac{dy}{dy} = 2x e^{3x} + 3x^2 e^{3x}$

$= x e^{3x}(2 + 3x)$

Workbook page 6. Try it on your own first.

WORKING

3

Level 1

2 marks

Tech-free

Solo: 3 min

WORKBOOK

Page 6

UP NEXT

Q4 Drug concentration model

Derivative toolkit: working

Tutor works this one live. 2 marks

QUESTION

4

Level 3

4 marks

Tech-active

Solo: 8 min

WORKBOOK

Page 7

UP NEXT

Q5 Stationary points and inflection

Drug concentration model

The concentration of a drug in a patient's blood is modelled by $C(t) = Ae^{-kt}$ mg L^{-1}, where t is the time in hours after the injection. Measurements show $C(1) = 48$ and $C(3) = 27$.

The drug is no longer effective once the concentration falls below 8 mg L^{-1}.

Determine how long after the injection this occurs, correct to the nearest minute. [4]

$48 = Ae^{-k}$

$A = \frac{48}{e^{-k}}$ (1)

$27 = Ae^{-k(3)}$ (2)

$27 = \frac{48}{e^{-k}} e^{-3k}$

$\frac{27}{48} = e^{-2k}$

$\ln \frac{27}{48} = -2k$

$k = \frac{1}{-2} \ln \frac{27}{48}$

Workbook page 7. Try it on your own first.

WORKING

4

Level 3

4 marks

Tech-active

Solo: 8 min

WORKBOOK

Page 7

UP NEXT

Q5 Stationary points and inflection

Drug concentration model: working

Tutor works this one live. 4 marks

$k = \frac{1}{2}\ln\left(\frac{16}{4}\right)$

$= \frac{1}{2}\ln\left(\frac{16}{4}\right)$

$k = \ln\left(\frac{4}{2}\right)$

$Ae^{-\ln\frac{4}{2}} = 48$

$A = 64$

$64e^{-\ln\frac{4}{2}t} = 8$

$t = 7.228$ hrs

$0.228 \times 60 = 14$ mins

7hr 14min

BLOCK 2 OF 7 · 3:30 TO 4:00 · UNIT 3

Applications of differentiation.

Julian | key ideas, then 4 questions

Applying derivatives: formulas and traps

Know which one to grab. Most of these are in the QCAA formula book.

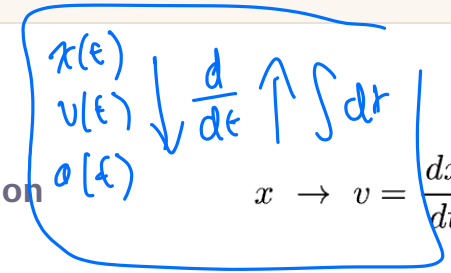
Stationary point	$f'(x) = 0$
Maximum	$f'(a) = 0$ and $f''(a) < 0$
Minimum	$f'(a) = 0$ and $f''(a) > 0$
Inflection	$f''(a) = 0$ and f'' changes sign at $x = a$

Common mistakes

- ✗ Stopping at f″ = 0 for an inflection point
- ✗ Giving θ when the question asks for the maximum AREA
- ✗ Not stating the domain or checking endpoints
- ✗ Mixing up displacement and distance
- ✗ Forgetting the + c when going back from v to x

Applying derivatives: formulas and traps

Know which one to grab. Most of these are in the QCAA formula book.



Motion $$x \;\to\; v = \frac{dx}{dt} \;\to\; a = \frac{dv}{dt}$$

Back again $$x(t) = \int v(t)\,dt, \qquad v(t) = \int a(t)\,dt$$

Common mistakes

- ✗ Stopping at f″ = 0 for an inflection point
- ✗ Giving θ when the question asks for the maximum AREA
- ✗ Not stating the domain or checking endpoints
- ✗ Mixing up displacement and distance
- ✗ Forgetting the + c when going back from v to x

Stationary points: the full justification

QCAA wants the reason, not just the answer.

Find

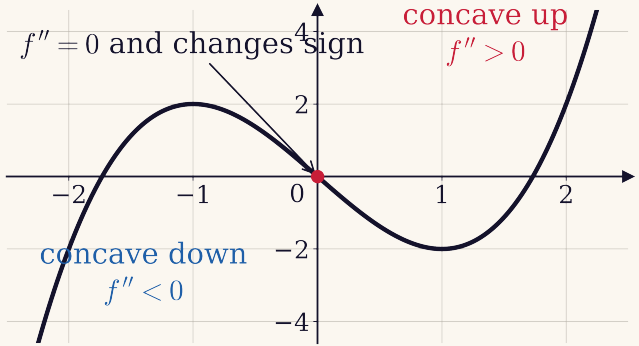
Solve $f'(x) = 0$ in the given domain.

Classify

$f'' < 0$: maximum. $f'' > 0$: minimum. $f'' = 0$: test either side.

Inflection

$f'' = 0$ is necessary. A sign change in f'' is sufficient. Show both.



QUESTION

5

Level 2

6 marks

Tech-free

Solo: 9 min

WORKBOOK

Page 9

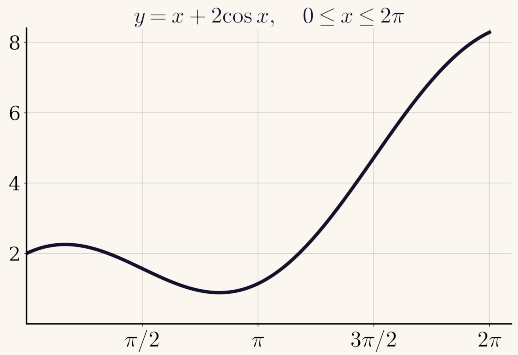
UP NEXT

Q6 Tangent triangle

Stationary points and inflection

Let $f(x) = x + 2\cos x$ for $0 \leq x \leq 2\pi$.

Determine the x-coordinates and nature of the stationary points of f, and show that the graph of f has a point of inflection at $x = \dfrac{\pi}{2}$. [6]



$f(x) = x + 2\cos(x)$

$f'(x) = 1 - 2\sin(x)$

let $f'(x) = 0$

$0 = 1 - 2\sin(x)$

Workbook page 9. Try it on your own first.

WORKING

5

Level 2

6 marks

Tech-free

Solo: 9 min

WORKBOOK

Page 9

UP NEXT

Q6 Tangent triangle

Stationary points and inflection: working

Tutor works this one live. 6 marks

$f'(\pi) = 1 - 2\sin(\pi)$

$0 = 1 - 2\sin(\pi)$

$-1 = -2\sin(\pi)$

$\frac{1}{2} = \sin(\pi)$

$\pi = \pi/6 , 5\pi/6$

$f''(\pi) = -2\cos(\pi)$

sub in $\pi = \pi/6$

$f''(\pi/6) = -2\cos(\pi/6)$

$= -2\left(\sqrt{3}/2\right)$

$= -\sqrt{3}$

$-\sqrt{3} < 0$

$\therefore$ S.P @ $\pi = \pi/6$ is a maximum

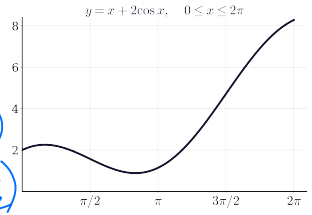
$f''(5\pi/6) = -2\cos(5\pi/6)$

$= -2\left(-\sqrt{3}/2\right)$

$= \sqrt{3}$

$\sqrt{3} > 0$

S.P @ $\pi = 5\pi/6$ is a minimum



$f''(\pi/2) = -2\cos(\pi/2)$

$= -2(0)$

$= 0$ $\therefore$ P.O.I

QUESTION

6

Level 2

4 marks

Tech-free

Solo: 6 min

WORKBOOK

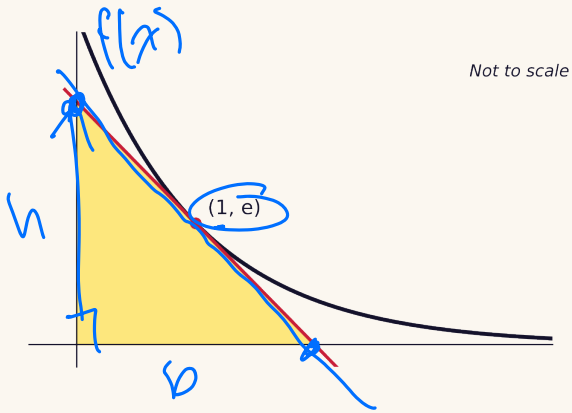
Page 10

UP NEXT

Q7 Brick optimisation

Tangent triangle

The tangent to the graph of $y = e^{2-x}$ at the point $(1,\ e)$ forms a triangle with the coordinate axes, as shown (not to scale).



Determine the exact area of this triangle. [4]

$A = \frac{bh}{2}$

$f(x) = e^{2-x}$

$f'(x) = -e^{2-x}$

$f'(1) = -e^{2-1}$

$= -e$

$\therefore m = -e$

$y = mx + c$

$\therefore y = -ex + c$

sub in $(1, e)$

$e = -e(1) + c$

$e = -e + c$

$\therefore c = 2e$

Workbook page 10. Try it on your own first.

WORKING

6

Level 2

4 marks

Tech-free

Solo: 6 min

WORKBOOK

Page 10

UP NEXT

Q7 Brick optimisation

Tangent triangle: working

Tutor works this one live. 4 marks

$\therefore y = -ex + 2e$

x int $\Rightarrow y = 0$

$0 = -ex + 2e$

$-2e = -ex$

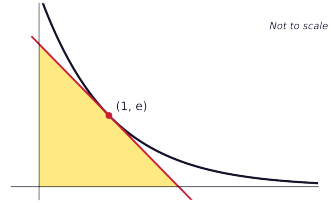
$x = \frac{-2e}{-e}$

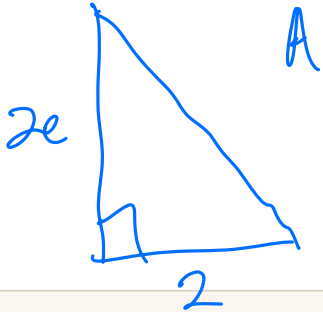
$= 2$

y int $\Rightarrow x = 0$

$y = -e(0) + 2e$

$\therefore y = 2e$





$A = \frac{2e \times 2}{2}$

$= \frac{4e}{2}$

$= 2e \text{ units}^2$

QUESTION

7

Level 3

6 marks

Tech-free

Solo: 10 min

WORKBOOK

Page 11

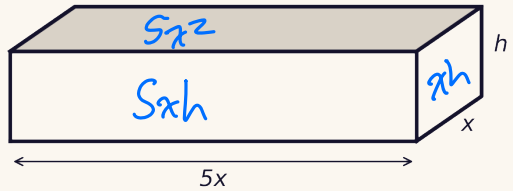
UP NEXT

Q8 Motion with two unknowns

Brick optimisation

A solid brick in the shape of a cuboid measures $5x$ cm long, x cm wide and h cm high. The total surface area of the brick is 720 cm^2.

Determine the exact maximum volume of the brick, and justify that it is a maximum. [6]



$V = (5x)(x)(h)$

$= 5x^2h$

$= (5x)(xh)$

$SA = 2(5xh + 5x^2 + xh)$

$720 = 2(5xh + 5x^2 + xh)$

$360 = 5xh + 5x^2 + xh$

$360 = 6xh + 5x^2$

$\therefore 6xh = 360 - 5x^2$

Workbook page 11. Try it on your own first.

WORKING

7

Level 3

6 marks

Tech-free

Solo: 10 min

WORKBOOK

Page 11

UP NEXT

Q8 Motion with two unknowns

Brick optimisation: working

Tutor works this one live. 6 marks

$V = (5x)(x)(h)$

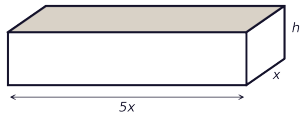
$6V = (5x)(6x)(h)$

$= (5x)(360 - 5x^2)$

$6V = 360(5x) - 25x^3$

$\therefore V = \frac{360(5x)}{6} - \frac{25x^3}{6}$

$\left[V = 300x - \frac{25x^3}{6}\right]$



$V' = 300 - \frac{25x^2}{2}$

let $V' = 0$

$0 = 300 - \frac{25x^2}{2}$

$-300 = -\frac{25x^2}{2}$

$-600 = -25x^2$

Optimisation in five lines

The same recipe works for areas, costs, volumes and angles.

1. One variable

Write the quantity using only one variable. Use the diagram.

2. Differentiate and solve

Set the derivative to 0. Reject values outside the domain.

3. Justify and answer

Second derivative test, then answer what was asked, with units.

QUESTION

8

Level 3

5 marks

Tech-free

Solo: 9 min

WORKBOOK

Page 12

UP NEXT

Break

Motion with two unknowns

A particle moves in a straight line with velocity $v(t) = p\cos(qt)$ m s^{-1}, where p and q are positive constants and $t \geq 0$ is in seconds. Its initial velocity is 6 m s^{-1} and it first comes to rest at $t = \pi$ s. Its initial displacement is 0 m.

Determine the total distance travelled by the particle in the first 2π seconds. [5]

$x(t)$
$v(t)$
$a(t)$
$\downarrow \frac{d}{dt}$ $\uparrow \int dt$

$\therefore v(t) = 6\cos(qt)$

@ $t = \pi$, $v(t) = 0$

$0 = 6\cos(q\pi)$

$\therefore q\pi = \pi/2$

$\therefore q = 1/2$

$\therefore v(t) = 6\cos(\frac{1}{2}t)$

$v(t) = p\cos(qt)$

@ $t = 0$, $v(t) = 6$

$v(0) = p\cos(q(0))$

$(6) = p\cos(0)$

$\therefore p = 6$

Workbook page 12. Try it on your own first.

WORKING

8

Level 3

5 marks

Tech-free

Solo: 9 min

WORKBOOK

Page 12

UP NEXT

Break

Motion with two unknowns: working

Tutor works this one live. 5 marks

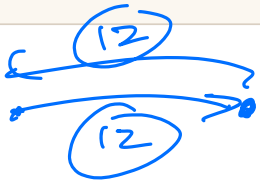
$v(t) = 6\cos\left(\frac{1}{2}t\right)$

$x(t) = \int v(t)\,dt$

$= \int 6\cos\left(\frac{1}{2}t\right)dt$

$= 6\int \cos\left(\frac{1}{2}t\right)dt$

$x(t) = 12\sin\left(\frac{1}{2}t\right) + c$



∴ Total distance

$= 12 + 12$

∴ 24 units

@ $t = 0$, $x(t) = 0$

$x(0) = 12\sin\left(\frac{1}{2}(0)\right) + c$

$0 = 12\sin\left(\frac{1}{2}0\right) + c$

$= 0 + c$

$\therefore c = 0$

$x(t) = 12\sin\left(\frac{1}{2}t\right)$

$x(\pi) = 12\sin\left(\frac{\pi}{2}\right)$

$= 12(1)$

$= 12$

$x(2\pi) = 12\sin\left(\frac{2\pi}{2}\right)$

$= 12\sin(\pi)$

$= 12(0)$

$= 0$

10 MIN BREAK

Break / Blooket

Back at 4:10

Grab your phone for a quick Blooket round on today's content.
Join at play.blooket.com with the game ID.

play.blooket.com | Game ID: _____

Blooket

Integration.

Senula | key ideas, then 3 questions

Integration: formulas and traps

Know which one to grab. Most of these are in the QCAA formula book.

Exponential

$$\int e^{kx}\,dx = \frac{1}{k}e^{kx} + c$$

Reciprocal

$$\int \frac{1}{x}\,dx = \ln|x| + c$$

Trig

$$\int \sin(kx)\,dx = -\frac{1}{k}\cos(kx) + c$$

$$\int \cos(kx)\,dx = \frac{1}{k}\sin(kx) + c$$

Common mistakes

- ✗ Multiplying by k instead of dividing
- ✗ Bottom minus top gives a negative area
- ✗ Missing an intersection point
- ✗ Writing ln x instead of ln|x| in indefinite integrals
- ✗ Forgetting the exact form (leave ln 2, e, π)

Integration: formulas and traps

Know which one to grab. Most of these are in the QCAA formula book.

Definite

$$\int_a^b f(x)\,dx = F(b) - F(a)$$

Between curves

$$\text{Area} = \int (\text{top} - \text{bottom})\,dx$$

Tangent line

$$y - f(a) = f'(a)(x - a)$$

Common mistakes

- ✗ Multiplying by k instead of dividing
- ✗ Bottom minus top gives a negative area
- ✗ Missing an intersection point
- ✗ Writing ln x instead of ln|x| in indefinite integrals
- ✗ Forgetting the exact form (leave ln 2, e, π)

Area between curves

Intersections, top minus bottom, integrate.

Intersections

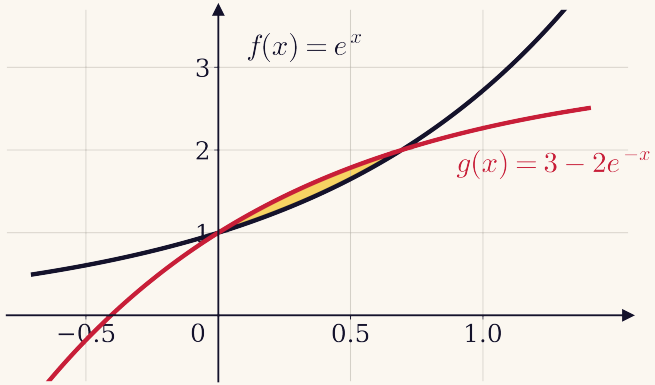
Set the curves equal. Often a hidden quadratic in e^x.

Top minus bottom

Test a value in between to see which is above.

Split at crossings

If the curves swap over, split the integral at that point.



QUESTION

9

Level 1

2 marks

Tech-free

Solo: 3 min

WORKBOOK

Page 14

UP NEXT

Q10 Area between two curves

Integration warm-up

Evaluate the definite integral

$$\int_0^{\pi/4} 8\cos(2x)\,dx. \quad [2]$$

$$\left[8\,\frac{1}{2}\sin(2x)\right]_0^{\frac{\pi}{4}}$$

$$\left[4\sin(2x)\right]_0^{\frac{\pi}{4}} \rightarrow 4\sin\left(\frac{\pi}{2}\right) - 4\sin(0)$$

$$4(1) - 0$$

$$= 4$$

Workbook page 14. Try it on your own first.

WORKING

9

Level 1

2 marks

Tech-free

Solo: 3 min

WORKBOOK

Page 14

UP NEXT

Q10 Area between two curves

Integration warm-up: working

Tutor works this one live. 2 marks

QUESTION

10

Level 2

5 marks

Tech-free

Solo: 8 min

WORKBOOK

Page 15

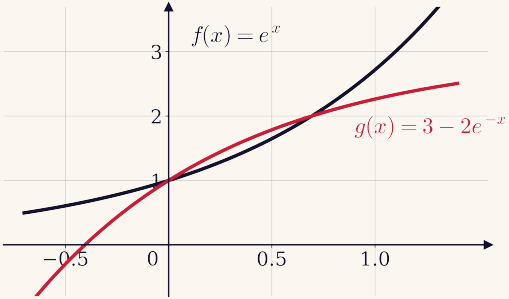
UP NEXT

Q11 Tangent to ln x

Area between two curves

The graphs of $f(x) = e^x$ and $g(x) = 3 - 2e^{-x}$ are shown.

Determine the exact area of the region enclosed by the graphs of f and g. [5]



$(e^x = 3 - 2e^{-x})e^x$

$e^{2x} = 3e^x - 2$

$(e^x)^2 - 3e^x + 2 = 0$

$e^x = A$

Workbook page 15. Try it on your own first.

WORKING

10

Level 2

5 marks

Tech-free

Solo: 8 min

WORKBOOK

Page 15

UP NEXT

Q11 Tangent to ln x

Area between two curves: working

Tutor works this one live. 5 marks

$A^2 - 3A + 2 = 0$

$(A-2)(A-1) = 0$

$A = 2 \quad A = 1$

$e^x = 2 \quad e^x = 1$

$x = \ln(2) \quad x = 0$

$$\int_0^{\ln(2)} (3 - 2e^{-x}) - e^x \, dx$$

$$\left[3x + 2e^{-x} - e^x\right]_0^{\ln(2)}$$

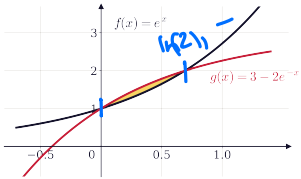
$$(3\ln 2 + 2e^{-\ln 2} - e^{\ln 2}) - (3(0) + 2e^{-0} - e^0)$$

$$= (3\ln 2 + 2\frac{1}{e^{\ln 2}} - e^{\ln 2}) - (0 + 2(1) - 1)$$

$$= 3\ln 2 + 2\frac{1}{2} - 2) - 1$$

$$= 3\ln 2 + 1 - 2 - 1$$

$$= 3\ln 2 - 2$$



$e^{\ln x} = x$

QUESTION

11

Level 3

5 marks

Tech-free

Solo: 12 min

WORKBOOK

Page 16

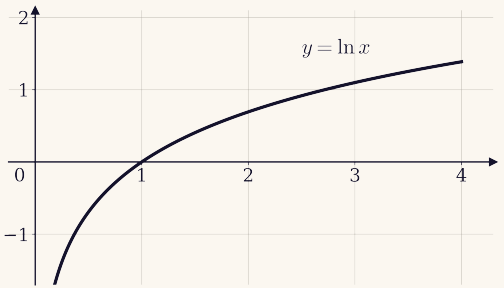
UP NEXT

Q12 Unit circle equation

Tangent to ln x

The straight line $y = mx$, where $m > 0$, is a tangent to the curve $y = \ln x$.

Given that $\dfrac{d}{dx}(x \ln x - x) = \ln x$, determine the exact area of the region bounded by the tangent, the curve $y = \ln x$ and the x-axis. [5]



Workbook page 16. Try it on your own first.

WORKING

11

Level 3

5 marks

Tech-free

Solo: 12 min

WORKBOOK

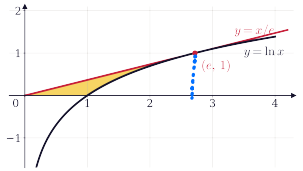
Page 16

UP NEXT

Q12 Unit circle equation

Tangent to ln x: working

Tutor works this one live. 5 marks



BLOCK 4 OF 7 · 4:35 TO 5:05 · UNIT 4

Trigonometry: triangles and 3D.

Julian | key ideas, then 4 questions

Trigonometry: formulas and traps

Know which one to grab. Most of these are in the QCAA formula book.

Sine rule $$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

Cosine rule $$c^2 = a^2 + b^2 - 2ab\cos C$$

Angle form $$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

Common mistakes

- ✗ Calculator in radians for a degrees question (the opposite of calculus!)
- ✗ Missing the second angle in the ambiguous case
- ✗ Using the cosine rule with an angle that is not between the two sides
- ✗ Mixing up angle of elevation and depression
- ✗ Drawing a 3D question as one flat triangle

Trigonometry: formulas and traps

Know which one to grab. Most of these are in the QCAA formula book.

Area	$\text{Area} = \frac{1}{2}ab\sin C$
Exact values	$\sin 150^\circ = \frac{1}{2}, \quad \cos 150^\circ = -\frac{\sqrt{3}}{2}$
Elevation	$\tan\theta = \frac{\text{height}}{\text{horizontal}}$

Common mistakes

- ✗ Calculator in radians for a degrees question (the opposite of calculus!)
- ✗ Missing the second angle in the ambiguous case
- ✗ Using the cosine rule with an angle that is not between the two sides
- ✗ Mixing up angle of elevation and depression
- ✗ Drawing a 3D question as one flat triangle

Trig graphs: a, b, c and d

$y = a\sin(b(x - c)) + d$. Read them off the graph in this order.

d: median line and a: amplitude

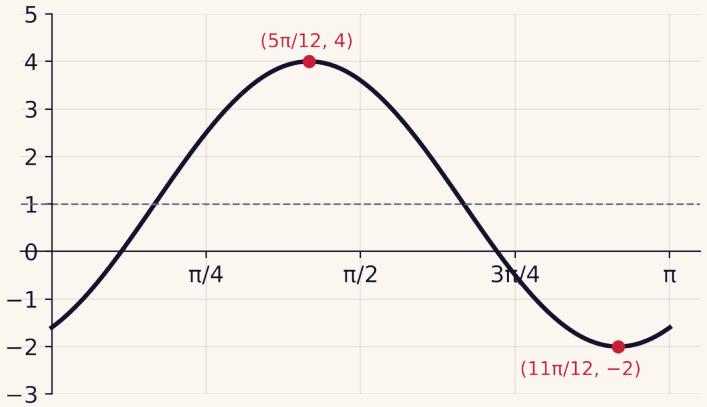
d = (max + min)/2 sits in the middle. a = (max − min)/2 is the distance from the median to a peak.

b: from the period

Period = 2π / b. One full cycle is peak to next peak. Peak to trough is only HALF a period.

c: phase shift

Where the sine graph crosses the median line going UP. Shift right by c.



QUESTION

12

Level 1

3 marks

Tech-free

Solo: 4 min

WORKBOOK

Page 18

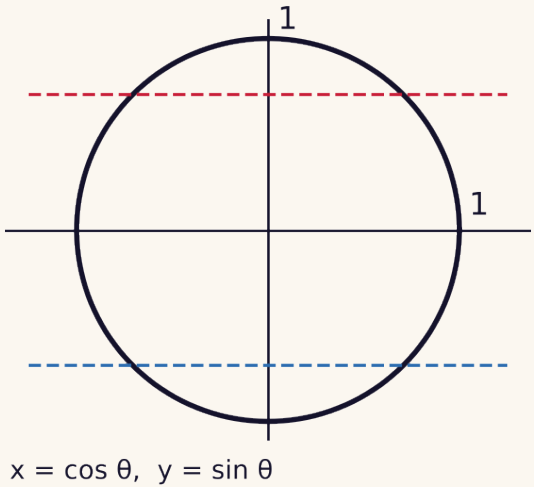
UP NEXT

Q13 Reading a trig graph

Unit circle equation

Consider the equation $2\sin^2\theta - 1 = 0$.

Solve the equation for $0 \leq \theta \leq 2\pi$. [3]



Workbook page 18. Try it on your own first.

WORKING

12

Level 1

3 marks

Tech-free

Solo: 4 min

WORKBOOK

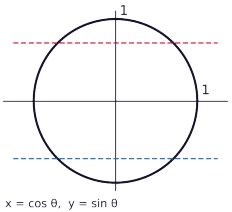
Page 18

UP NEXT

Q13 Reading a trig graph

Unit circle equation: working

Tutor works this one live. 3 marks



QUESTION

13

Level 2

4 marks

Tech-free

Solo: 6 min

WORKBOOK

Page 19

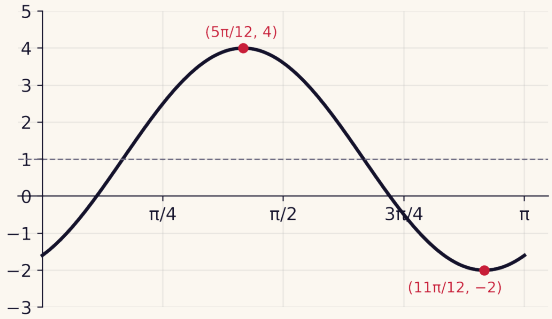
UP NEXT

Q14 Garden bed

Reading a trig graph

The graph of $y = a\sin(b(x-c)) + d$, where $a > 0$, $b > 0$ and $0 < c < \frac{\pi}{2}$, is shown. It has a maximum at $\left(\frac{5\pi}{12},\ 4\right)$ and a minimum at $\left(\frac{11\pi}{12},\ -2\right)$.

Determine the values of a, b, c and d. $[4]$



Workbook page 19. Try it on your own first.

WORKING

13

Level 2

4 marks

Tech-free

Solo: 6 min

WORKBOOK

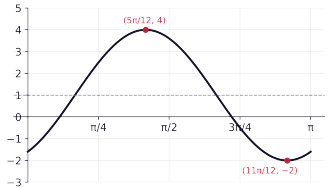
Page 19

UP NEXT

Q14 Garden bed

Reading a trig graph: working

Tutor works this one live. 4 marks



Which triangle rule?

Decide from what you are given, before you write anything.

Right angle

SOH CAH TOA, or Pythagoras. Elevation and depression are always right triangles.

Sine rule

You know a side AND its opposite angle, plus one more side or angle.

Cosine rule

Three sides, or two sides and the angle BETWEEN them. Area = ½ ab sin C uses the same angle.

QUESTION

14

Level 1

4 marks

Tech-free

Solo: 5 min

WORKBOOK

Page 20

UP NEXT

Q15 Lighthouse from two boats

Garden bed

A triangular garden bed has two sides of length 8 m and 5 m, with an angle of 150° between them.

Determine the exact area of the garden bed and the exact length of its third side. [4]

Workbook page 20. Try it on your own first.

WORKING

14

Level 1

4 marks

Tech-free

Solo: 5 min

WORKBOOK

Page 20

UP NEXT

Q15 Lighthouse from two boats

Garden bed: working

Tutor works this one live. 4 marks

The ambiguous case: one angle, two triangles

AB = 12 cm, BC = 9 cm, angle A = 40°. Find angle C.

Sine rule gives sin C

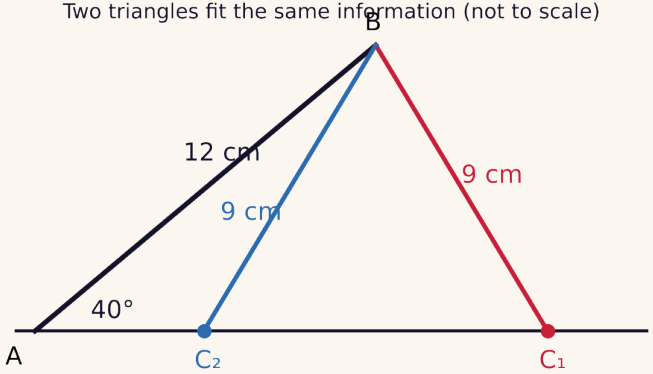
sin C / 12 = sin 40° / 9, so sin C = 0.857. The calculator says C = 59.0°.

But sin is positive twice

C = 180° − 59.0° = 121.0° also works. Check: 40° + 121° < 180°, so the triangle exists.

Why it happens

The 9 cm side is shorter than 12 cm, so it can swing to two places on the base: C_1 and C_2 .





3D questions: split into flat triangles

Lighthouses, towers, flagpoles, drones.

Vertical triangles

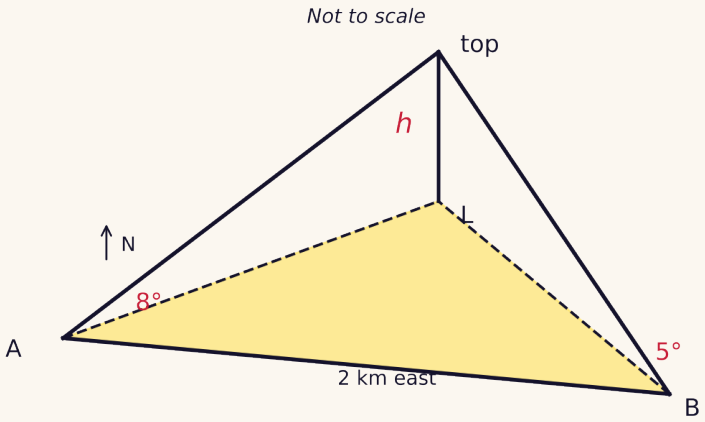
Height and horizontal distance, with the angle of elevation at ground level.

Ground triangle

Bearings and directions live here. Due south then due east means a right angle.

Link them

Write each horizontal distance in terms of the height, then one equation in one unknown.



QUESTION

15

Level 3

5 marks

Tech-active

Solo: 10 min

WORKBOOK

Page 21

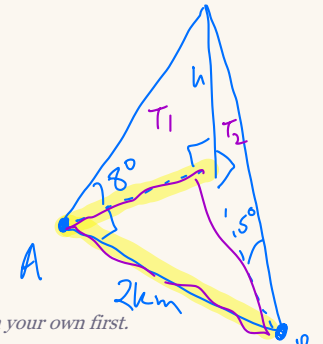
UP NEXT

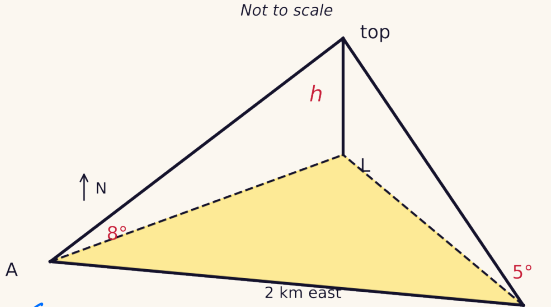
Q16 Discrete random variable

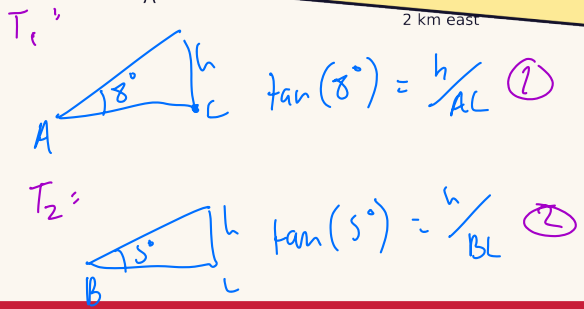
Lighthouse from two boats

A boat at A is due south of a lighthouse L. From A, the angle of elevation of the top of the lighthouse is 8°. The boat then sails 2 km due east to B, where the angle of elevation of the top is 5°.

Determine the height of the lighthouse, correct to the nearest metre. [5]







Workbook page 21. Try it on your own first.

WORKING

15

Level 3

5 marks

Tech-active

Solo: 10 min

WORKBOOK

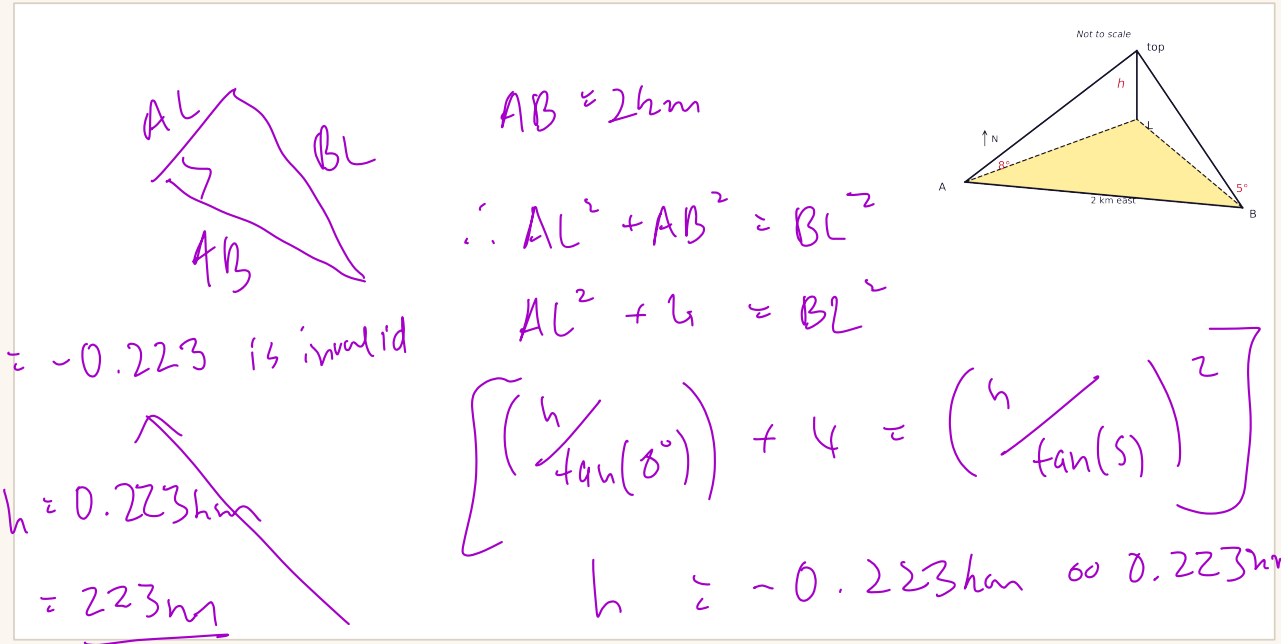
Page 21

UP NEXT

Q16 Discrete random variable

Lighthouse from two boats: working

Tutor works this one live. 5 marks



BLOCK 5 OF 7 · 5:05 TO 5:30 · UNIT 3

Discrete probability and binomial.

Rishabh | key ideas, then 3 questions

MOST REQUESTED

Discrete and binomial: formulas and traps

Know which one to grab. Most of these are in the QCAA formula book.

Expected value

$$E(X) = \sum x\, P(X = x)$$

Variance

$$\mathrm{Var}(X) = \sum p_i\,(x_i - \mu)^2$$

Binomial

$$P(X = x) = \binom{n}{x} p^x (1-p)^{n-x}$$

Common mistakes

- ✗ Var(X) = E(X²) − E(X), forgetting to square
- ✗ 'At least 2' means 1 − P(X ≤ 1), not 1 − P(X ≤ 2)
- ✗ Using binomcdf when the question wants exactly one value
- ✗ Dividing by the wrong thing in conditional probability
- ✗ Rounding too early in multi-step questions

Discrete and binomial: formulas and traps

Know which one to grab. Most of these are in the QCAA formula book.

Binomial mean and variance

$$E(X) = np, \qquad \mathrm{Var}(X) = np(1-p)$$

Conditional

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$$

Common mistakes

- ✗ Var(X) = E(X²) − E(X), forgetting to square
- ✗ 'At least 2' means 1 − P(X ≤ 1), not 1 − P(X ≤ 2)
- ✗ Using binomcdf when the question wants exactly one value
- ✗ Dividing by the wrong thing in conditional probability
- ✗ Rounding too early in multi-step questions

Binomial or not?

B — **Binary outcomes**

Each trial has exactly two outcomes: success or failure.

I — **Independent trials**

One trial does not affect another. State it as an assumption in context.

N — **Number of trials fixed**

A set number of trials (20 bulbs, 30 bolts).

S — **Same probability of success**

Success or failure with the same probability each time.

QUESTION

16

Level 1

4 marks

Tech-free

Solo: 5 min

WORKBOOK

Page 23

UP NEXT

Q17 Faulty bulbs

Discrete random variable

A discrete random variable X has $P(X = x) = k(5 - x)$ for $x \in \{1, 2, 3, 4\}$.

a) Show that $k = 0.1$. [1]

b) Determine $E(X)$. [1]

c) Determine $\text{Var}(X)$. [2]

4k

x	1	2	3	4
$P(X=x)$	4k	3k	2k	k
	0.4	0.3	0.2	0.1

$1 = 4k + 3k + 2k + k$

$1 = 10k$

$k = 0.1$

$E(X) = 1 \times 0.4 + 2 \times 0.3 + 3 \times 0.2 + 0.1 \times 4$

$= 0.4 + 0.6 + 0.6 + 0.4$

$= 2$

Workbook page 23. Try it on your own first.

WORKING

16

Level 1

4 marks

Tech-free

Solo: 5 min

WORKBOOK

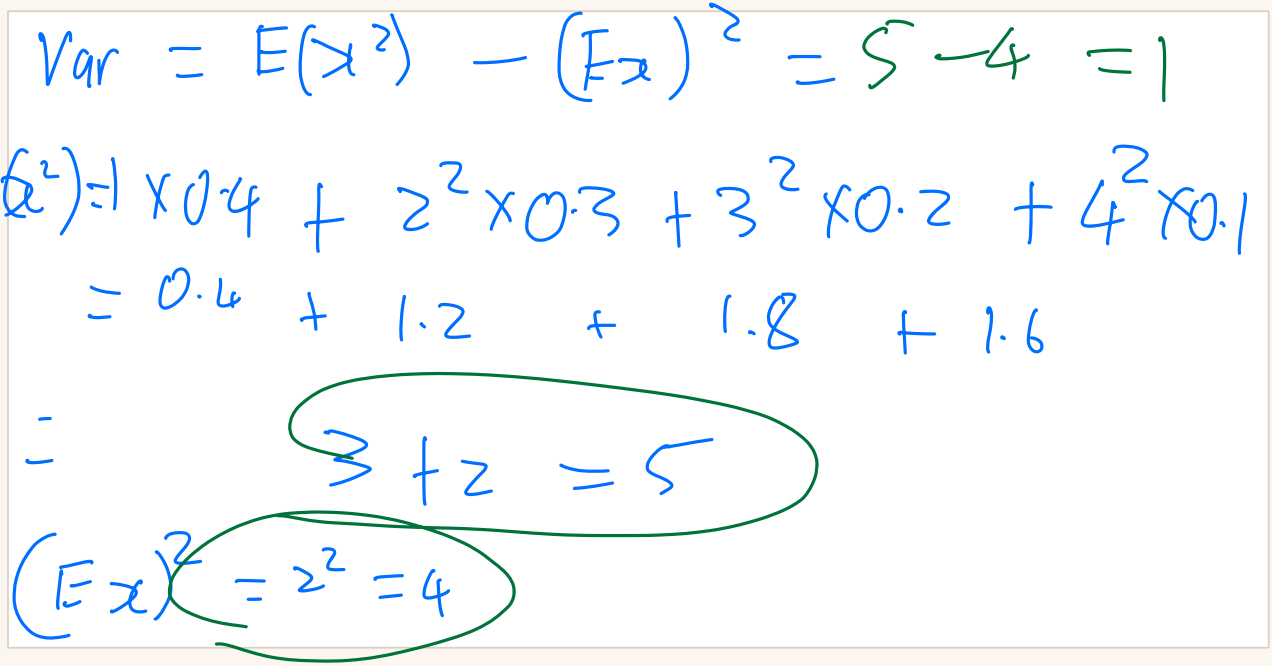
Page 23

UP NEXT

Q17 Faulty bulbs

Discrete random variable: working

Tutor works this one live. 4 marks



QUESTION

17

Level 2

4 marks

Tech-active

Solo: 7 min

WORKBOOK

Page 24

UP NEXT

Q18 Late to school

Faulty bulbs

Each light bulb in a box of 20 is faulty with probability 0.08, independently of the others. Let X be the number of faulty bulbs in a box.

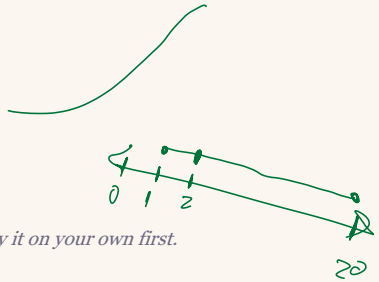
A box is found to contain at least one faulty bulb. Determine the probability that it contains exactly 2 faulty bulbs. [4]

$$P(X=2 \mid X\geq 1) = \frac{P(X=2 \cap X\geq 1)}{P(X\geq 1)}$$

$$= \frac{P(X=2)}{P(X\geq 1)}$$

$$= \frac{0.2711}{0.8113}$$

$$= 0.3342$$



Workbook page 24. Try it on your own first.

WORKING

17

Level 2

4 marks

Tech-active

Solo: 7 min

WORKBOOK

Page 24

UP NEXT

Q18 Late to school

Faulty bulbs: working

Tutor works this one live. 4 marks

Conditional probability on the calculator

Write the fraction first, then compute.

Step 1

Write $P(A \mid B) = \dfrac{P(A \cap B)}{P(B)}$ in symbols.

Step 2

Find each piece: binomPdf for one value, binomCdf for a range.

Step 3

Divide and round at the end, to 4 decimal places.

QUESTION

18

Level 2

4 marks

Technique

Solo: 6 min

WORKBOOK

Page 25

UP NEXT

Break

Late to school

Students travel to school by train (45%), bus (35%) or on foot (20%). The probability that a student is late is 0.08 for train, 0.12 for bus and 0.05 for walkers.

A randomly chosen student is late. Determine the probability that they caught the bus. [4]

B : student being late

A : student taking the bus

Workbook page 25. Try it on your own first.

WORKING

18

Level 2

4 marks

Tech-free

Solo: 6 min

WORKBOOK

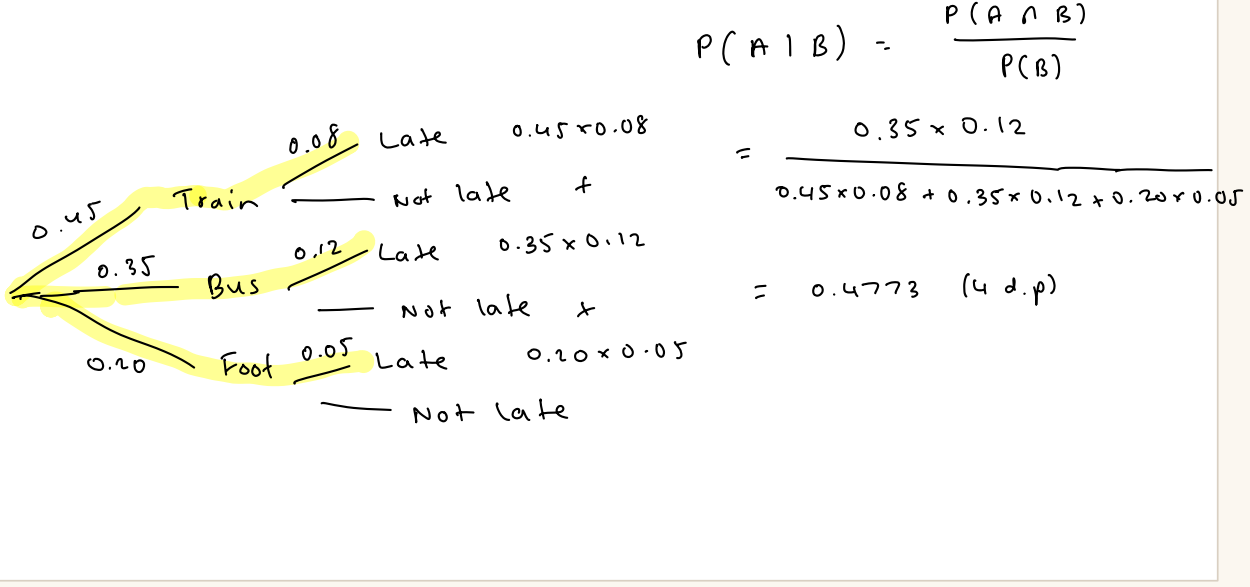
Page 25

UP NEXT

Break

Late to school: working

Tutor works this one live. 4 marks



WORKING

18

Level 2

4 marks

Tech-free

Solo: 6 min

WORKBOOK

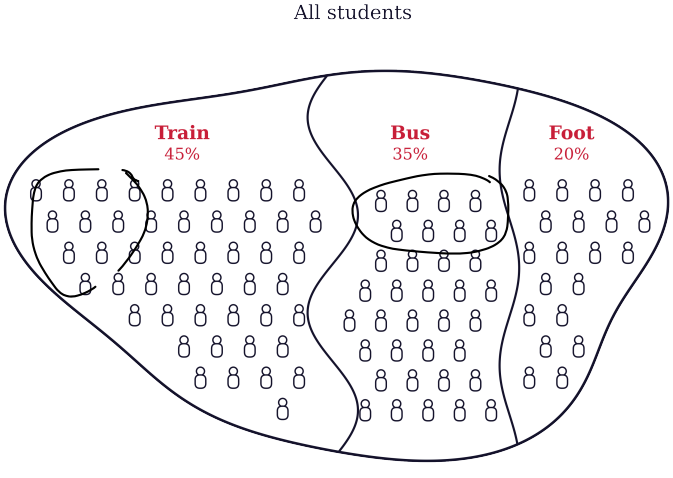
Page 25

UP NEXT

Break

Late to school: working

Tutor works this one live. 4 marks



10 MIN BREAK

Break

Back at 5:40

Stretch, drink some water, and look back at one question you got wrong. Then scan the code: 60 seconds, totally anonymous.



Quick feedback (60 sec)

BLOCK 6 OF 7 · 5:40 TO 6:00 · UNIT 4

Continuous random variables and the normal.

Senula + Julian | key ideas, then 3 questions

Continuous and normal: formulas and traps

Know which one to grab. Most of these are in the QCAA formula book.

Total area

$$\int_{\text{domain}} f(x)\,dx = 1$$

Probability

$$P(a < X < b) = \int_a^b f(x)\,dx$$

Mean

$$E(X) = \int x\, f(x)\,dx$$

Common mistakes

- ✗ Forgetting f(x) is 0 outside the domain
- ✗ Using σ^2 where the calculator wants σ
- ✗ Inverse normal with the wrong tail
- ✗ Treating the PDF value as a probability
- ✗ Not giving units (g, minutes) in the final answer

Continuous and normal: formulas and traps

Know which one to grab. Most of these are in the QCAA formula book.

Variance

$$\text{Var}(X) = E(X^2) - \mu^2$$

CDF

$$F(x) = P(X \leq x) = \int_{\min}^{x} f(t)\,dt$$

Standardise

$$z = \frac{x - \mu}{\sigma}$$

Common mistakes

- ✗ Forgetting f(x) is 0 outside the domain
- ✗ Using σ² where the calculator wants σ
- ✗ Inverse normal with the wrong tail
- ✗ Treating the PDF value as a probability
- ✗ Not giving units (g, minutes) in the final answer

The normal distribution

Sketch it every time. Shade what you want.

Forwards

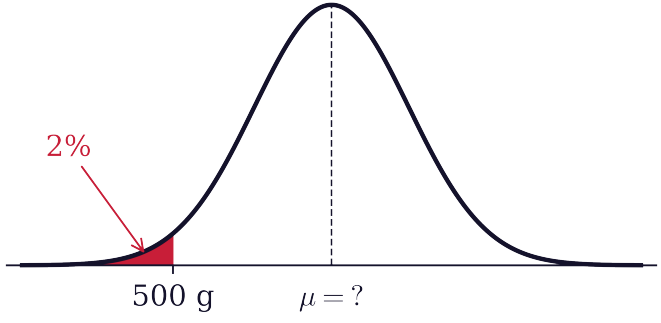
Given x, find a probability:
normCdf(lower, upper, μ, σ).

Backwards

Given a probability, find x or μ: invNorm with the **left**-tail area.

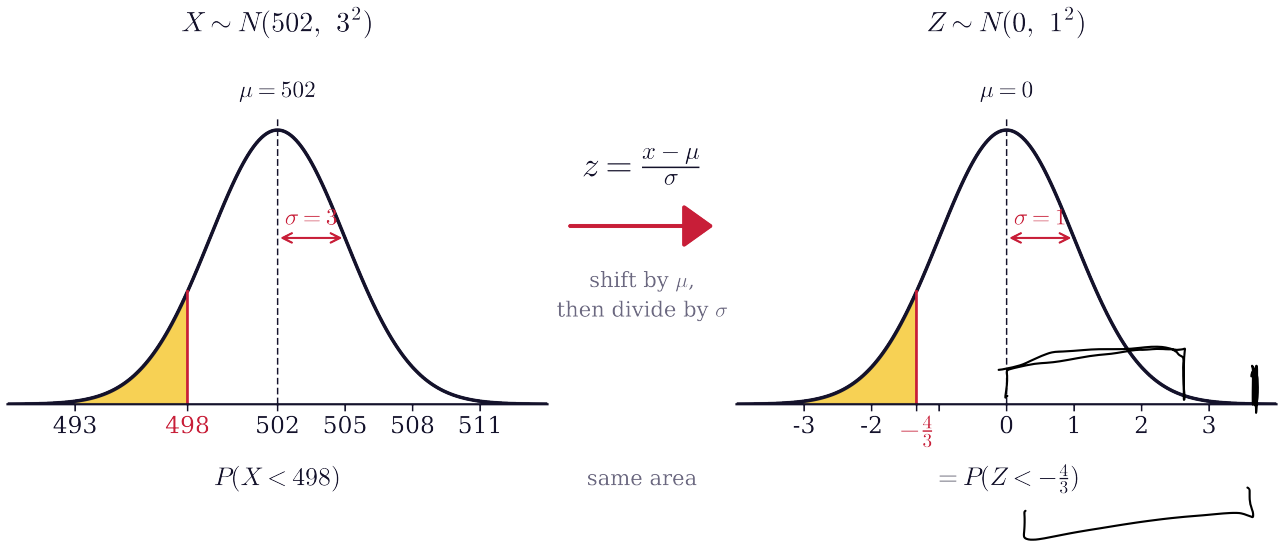
68, 95, 99.7

About 95% of values are within 2σ of the mean. Useful as a sanity check.



Why standardise?

Obtaining the z-score is equivalent to transforming the normal curve



Why standardise? LeBron vs Ronaldo

Two different distributions. Raw averages cannot be compared, z-scores can.

Who is the bigger outlier in their league?

	LeBron James (points per game)	**Cristiano Ronaldo** (goals per match)
Player average, x	26.8	0.73
League mean, μ	10.5	0.13
League standard deviation, σ	6.2	0.16

$$z = \frac{x - \mu}{\sigma}$$

lebron

$$z = \frac{26.8 - 10}{6.2} = 2.7096$$

ronaldo:

$$z = \frac{0.73 - 0.13}{0.16} = 3.75$$

QUESTION

19

Level 2

6 marks

Tech-active

Solo: 9 min

WORKBOOK

Page 27

UP NEXT

Q20 Packet masses

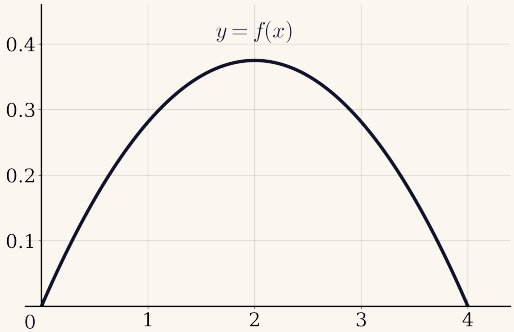
Probability density function

A continuous random variable X has probability density function $f(x) = kx(4-x)$ for $0 \leq x \leq 4$, and $f(x) = 0$ elsewhere.

a) Show that $k = \frac{3}{32}$. [2]

b) Determine $P(X > 3)$. [2]

c) Determine $\text{Var}(X)$. [2]



Workbook page 27. Try it on your own first.

WORKING

19

Level 2

6 marks

Tech-active

Solo: 9 min

WORKBOOK

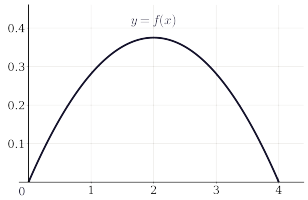
Page 27

UP NEXT

Q20 Packet masses

Probability density function: working

Tutor works this one live. 6 marks



QUESTION

20

Level 2

4 marks

Tech-active

Solo: 6 min

WORKBOOK

Page 28

UP NEXT

Q21 Two orchards

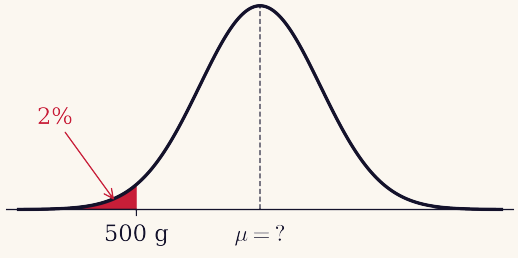
Packet masses

The mass of a packet of rice is normally distributed with mean 502 g and standard deviation 3 g.

a) Determine the probability that a packet has a mass under 495 g. [1]

b) Determine $P(498 < \text{mass} < 505)$. [1]

c) The machine is adjusted so that only 2% of packets are under 500 g. The standard deviation is unchanged. Determine the new mean, correct to one decimal place. [2]



Workbook page 28. Try it on your own first.

WORKING

20

Level 2

4 marks

Tech-active

Solo: 6 min

WORKBOOK

Page 28

UP NEXT

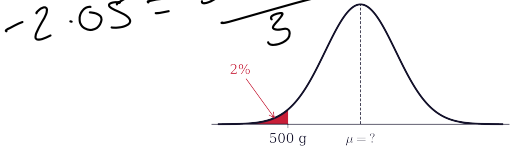
Q21 Two orchards

Packet masses: working

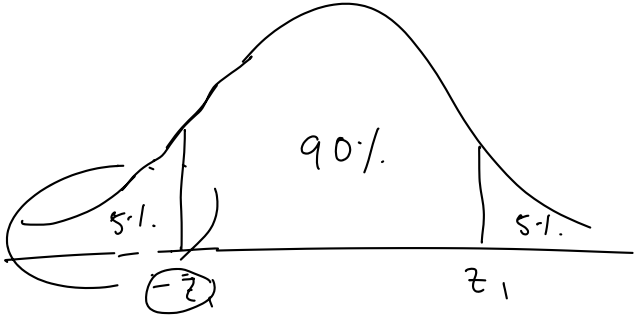
Tutor works this one live. 4 marks

$$z = \frac{x - \mu}{\sigma}$$

$$-2.05 = \frac{500 - \mu}{3}$$



$$\mu = 506.15$$



QUESTION

21

Level 3

5 marks

Tech-active

Solo: 9 min

WORKBOOK

Page 29

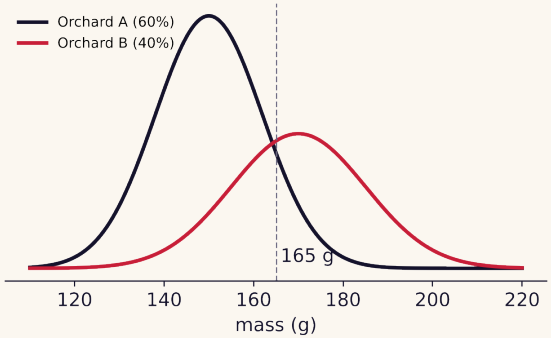
UP NEXT

Q22 Working backwards from an interval

Two orchards

Apples from orchard A have masses that are normally distributed with mean 150 g and standard deviation 12 g. Apples from orchard B have masses that are normally distributed with mean 170 g and standard deviation 15 g. A crate contains 60% orchard A apples and 40% orchard B apples.

An apple chosen at random from the crate has a mass greater than 165 g. Determine the probability that it came from orchard B. [5]



Workbook page 29. Try it on your own first.

WORKING

21

Level 3

5 marks

Tech-active

Solo: 9 min

WORKBOOK

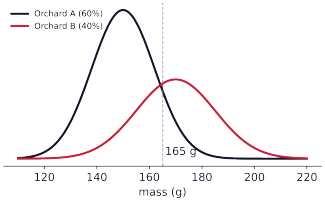
Page 29

UP NEXT

Q22 Working backwards from an interval

Two orchards: working

Tutor works this one live. 5 marks



BLOCK 7 OF 7 · 6:00 TO 6:25 · UNIT 4

Sampling, confidence intervals and complex unfamiliar.

Senula + Rishabh | key ideas, then 3 questions

EXAM FOCUS

Intervals and CU: formulas and traps

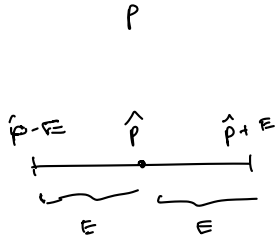
Know which one to grab. Most of these are in the QCAA formula book.

Sample proportion

$$\hat{p} = \frac{x}{n}$$

Standard error

$$\mathrm{SE} = \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$



Interval

$$(\hat{p} - z \cdot \mathrm{SE}, \quad \hat{p} + z \cdot \mathrm{SE})$$

$E = z\,SE$

error

Common mistakes

- ✗ Saying 'there is a 95% chance p is in this interval'
- ✗ Using a percentage (20) instead of a proportion (0.2)
- ✗ Saying a claim is 'proven' because it is inside the interval
- ✗ Not answering the claim in context
- ✗ Forgetting to define the binomial variable in CU questions

Intervals and CU: formulas and traps

Know which one to grab. Most of these are in the QCAA formula book.

z values	$90\%: \ 1.645 \qquad 95\%: \ 1.96 \qquad 99\%: \ 2.576$
Margin of error	$E = z \cdot \text{SE} \qquad (\text{width} = 2E)$
More confidence	$\text{wider interval}; \ \text{bigger } n: \ \text{narrower interval}$

Common mistakes

- ✗ Saying 'there is a 95% chance p is in this interval'
- ✗ Using a percentage (20) instead of a proportion (0.2)
- ✗ Saying a claim is 'proven' because it is inside the interval
- ✗ Not answering the claim in context
- ✗ Forgetting to define the binomial variable in CU questions

Confidence intervals: what QCAA asks

Three question types, every year.

Construct it

$\hat{p} \pm z\sqrt{\dfrac{\hat{p}(1-\hat{p})}{n}}$. Tech-free numbers make the root nice.

Use it

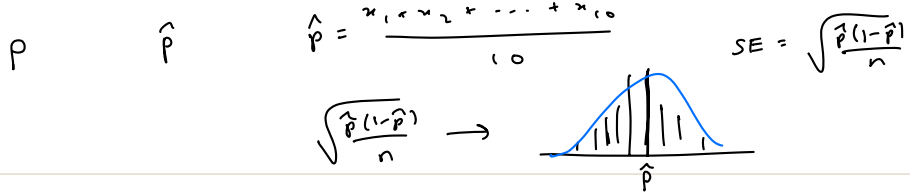
Is the claimed value inside or outside? Conclude in context.

Interpret it

95% of intervals built this way contain p. Not ‘a 95% chance’.

p vs. p̂

What's the difference?



- **p: the population proportion**

  One fixed number for EVERYONE (all customers, all voters). Usually unknown. It is what we are trying to estimate.

- **p̂: the sample proportion**

  p̂ = x/n from the sample we actually took. It changes from sample to sample, so it is a random variable.

- **How they connect**

  For large n, p̂ is approximately normal with mean p and SD √(p(1 − p)/n). The interval p̂ ± z·SE is our guess at where p is.



QUESTION

22

Level 3

6 marks

Tech-free

Solo: 12 min

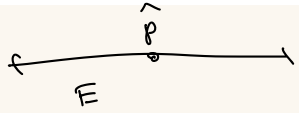
WORKBOOK

Page 31

UP NEXT

Q23 Defective bolts

Working backwards from an interval



A random sample of people were asked whether they support a new bike lane. Using $z = 1.96$, an approximate 95% confidence interval for the proportion who support it was calculated to be $(0.201,\ 0.299)$.

Determine how many people were surveyed, how many supported the bike lane, and the sample size that would be needed to halve the margin of error, assuming the same sample proportion. [6]

$E = z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$

$\hat{p} = \frac{0.201 + 0.299}{2} = 0.25$ $\quad E = \frac{0.299 - 0.201}{2} = 0.049$

$E = z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$ $\quad \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} = \frac{E}{z}$ $\quad \hat{p} = 0.25$

$n = \frac{z^2\hat{p}(1-\hat{p})}{E^2} = 300$ $\quad \frac{\hat{p}(1-\hat{p})}{n} = \frac{E^2}{z^2}$

Multiply n by 4 $\rightarrow n = 4 \times 300 = 120$

Workbook page 31. Try it on your own first.

WORKING

22

Level 3

6 marks

Tech-free

Solo: 12 min

WORKBOOK

Page 31

UP NEXT

Q23 Defective bolts

Working backwards from an interval: working

Tutor works this one live. 6 marks

How QCAA gives the marks

using GDC, invN(Central, 0.95, 1, 0)
z = 1.96

From the marking guides.

Recognise

Name the model, rule or calculator function: '$X \sim \text{Bin}(30,\, 0.05)$', 'product rule', 'binomCdf'.

Reason

Show the set-up: the integral, the fraction, the equation.

Result

Final answer with precision, units and a sentence in context.

Calculator traps and exam habits

Five things that cost marks every year.

Radians

Calculus with trig must be in radians. Check before Paper 2.

Rounding

Keep full values in memory. Round only the final answer.

Marks guide length

1 mark: one line. 5 marks: five key steps. Use the extra pages.

QUESTION

23

Level 3

6 marks

Tech-active

Solo: 12 min

WORKBOOK

Page 32

UP NEXT

Q24 Final boss: trig meets probability

Defective bolts



A machine makes bolts whose diameters are normally distributed with mean 10 mm and standard deviation 0.06 mm. A bolt is defective if its diameter is less than 9.9 mm. Bolts are sold in boxes of 20.

The manufacturer wants at most 20% of boxes to contain at least one defective bolt. The mean cannot be changed, but the standard deviation can be reduced by adjusting the machine. Determine the standard deviation required, correct to three decimal places. [6]

$X \sim N(10, 0.06^2)$ Defective: $X < 9.9 \rightarrow P(X < 9.9) = 0.04779$

$Y \sim Bin(20, 0.04779)$ $P(Y \geq 1) = 0.6245$ * want it to be 20%.

$1 - P(Y=0) = 1 - (1-p)^{20} = 0.20$

$p = 0.0111$

$P(X < 9.9) = 0.0111$

$z = \frac{x-\mu}{\sigma}$

$z = -2.2869$

$-2.2869 = \frac{9.9 - 10}{\sigma}$

Workbook page 32. Try it on your own first.

WORKING

23

Level 3

6 marks

Tech-active

Solo: 12 min

WORKBOOK

Page 32

UP NEXT

Q24 Final boss: trig meets probability

Defective bolts: working

Tutor works this one live. 6 marks

$\hat{p} = 0.0437$

QUESTION

24

Level 3

5 marks

Tech-free

Solo: 10 min

WORKBOOK

Page 33

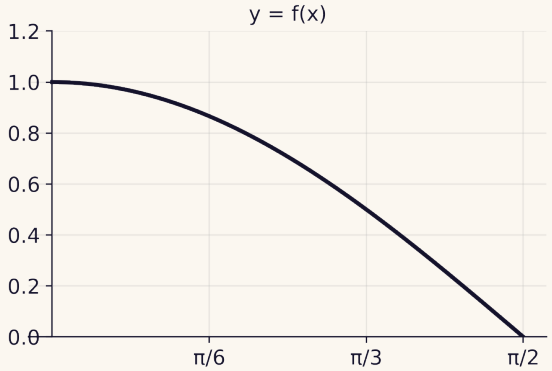
UP NEXT

Close

Final boss: trig meets probability

A continuous random variable X has probability density function $f(x) = k\cos x$ for $0 \leq x \leq \frac{\pi}{2}$, and $f(x) = 0$ elsewhere.

Determine the value of k, the exact median of X, and the exact value of $P(X > \frac{\pi}{3})$. [5]



Workbook page 33. Try it on your own first.

WORKING

24

Level 3

5 marks

Tech-free

Solo: 10 min

WORKBOOK

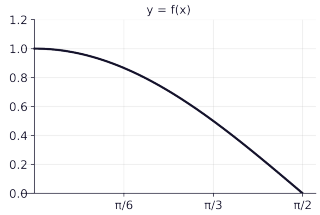
Page 33

UP NEXT

Close

Final boss: trig meets probability: working

Tutor works this one live. 5 marks



THAT'S A WRAP

You're ready.

Friday 13 November

Paper 1 (tech-free) AM · Paper 2 (tech-active) PM

Tonight: redo the one question you circled. Tomorrow: one past paper, timed. Thursday night: sleep.

