OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI)

4771

Decision Mathematics 1

QUESTION PAPER

Candidates answer on the printed answer book.

OCR supplied materials:
- Printed answer book 4771
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Wednesday 22 June 2011
Morning

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the printed answer book and the question paper.

- The question paper will be found in the centre of the printed answer book.
- Write your name, centre number and candidate number in the spaces provided on the printed answer book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the printed answer book**. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- You are permitted to use a graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

This information is the same on the printed answer book and the question paper.

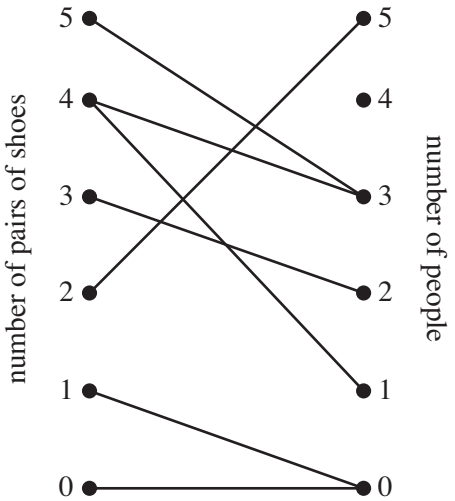
- The number of marks is given in brackets **[ ]** at the end of each question or part question on the question paper.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- The printed answer book consists of **12** pages. The question paper consists of **8** pages. Any blank pages are indicated.

INSTRUCTIONS TO EXAMS OFFICER/INVIGILATOR

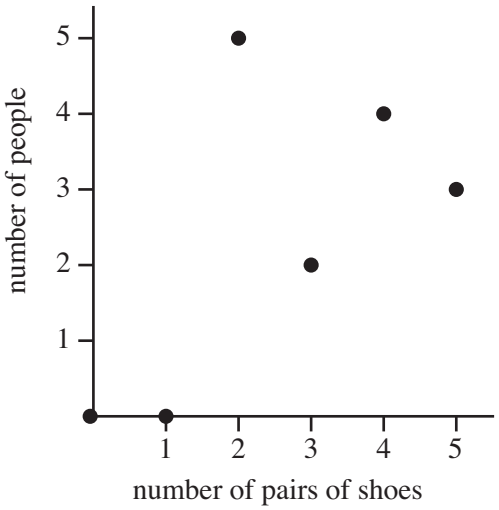
- Do not send this question paper for marking; it should be retained in the centre or destroyed.

Section A (24 marks)

1 Two students draw graphs to represent the numbers of pairs of shoes owned by members of their class. Andrew produces a bipartite graph, but gets it wrong. Barbara produces a completely correct frequency graph. Their graphs are shown below.



Andrew's graph



Barbara's graph

(i) Draw a correct bipartite graph. **[3]**

(ii) How many people are in the class? **[1]**

(iii) How many pairs of shoes in total are owned by members of the class? **[2]**

(iv) Which points on Barbara's graph may be deleted without losing any information? **[1]**

Charles produces the same frequency graph as Barbara, but joins consecutive points with straight lines.

(v) Criticise Charles's graph. **[1]**

2 The algorithm gives a method for drawing two straight lines, if certain conditions are met.

Start with the equations of the two straight lines

Line 1 is $ax + by = c, \quad a, b, c > 0$
Line 2 is $dx + ey = f, \quad d, e, f > 0$

Let X = minimum of $\frac{c}{a}$ and $\frac{f}{d}$

Let Y = minimum of $\frac{c}{b}$ and $\frac{f}{e}$

If $X = \frac{c}{a}$ then $X^* = \frac{c - bY}{a}$ and $Y^* = \frac{f - dX}{e}$

If $X = \frac{f}{d}$ then $X^* = \frac{f - eY}{d}$ and $Y^* = \frac{c - aX}{b}$

Draw an x-axis labelled from 0 to X, and a y-axis labelled from 0 to Y
Join $(0, Y)$ to (X, Y^*) with a straight line
Join (X^*, Y) to $(X, 0)$ with a straight line

(i) Apply the algorithm with $a = 1, b = 5, c = 25, d = 10, e = 2, f = 85$. **[7]**

(ii) Why might this algorithm be useful in an LP question? **[1]**

3 John has a standard die in his pocket (ie a cube with its six faces labelled from 1 to 6).

(i) Describe how John can use the die to obtain realisations of the random variable X, defined below.

x	1	2	3
Probability$(X = x)$	$\frac{1}{2}$	$\frac{1}{6}$	$\frac{1}{3}$

[3]

(ii) Describe how John can use the die to obtain realisations of the random variable Y, defined below.

y	1	2	3
Probability$(Y = y)$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{4}$

[3]

(iii) John attempts to use the die to obtain a realisation of a uniformly distributed 2-digit random number. He throws the die 20 times. Each time he records one less than the number showing. He then adds together his 20 recorded numbers.

Criticise John's methodology. **[2]**

Section B (48 marks)

4 An eco-village is to be constructed consisting of large houses and standard houses.

Each large house has 4 bedrooms, needs a plot size of 200 m^2 and costs £60 000 to build.

Each standard house has 3 bedrooms, needs a plot size of 120 m^2 and costs £50 000 to build.

The area of land available for houses is 120 000 m^2. The project has been allocated a construction budget of £42.4 million.

The market will not sustain more than half as many large houses as standard houses. So, for instance, if there are 500 standard houses then there must be no more than 250 large houses.

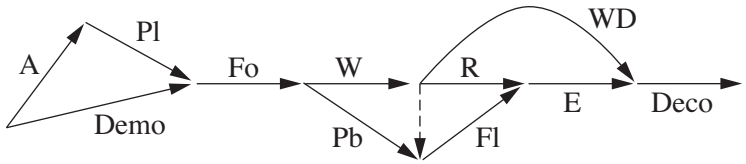
(i) Define two variables so that the three constraints can be formulated in terms of your variables. Formulate the three constraints in terms of your variables. **[5]**

(ii) Graph your three inequalities from part **(i)**, indicating the feasible region. **[4]**

(iii) Find the maximum number of bedrooms which can be provided, and the corresponding numbers of each type of house. **[2]**

(iv) Modify your solution if the construction budget is increased to £45 million. **[5]**

5 The activity network and table together show the tasks involved in constructing a house extension, their durations and precedences.



Activity	Description	Duration (days)
A	Architect produces plans	10
Pl	Obtain planning permission	14
Demo	Demolish existing structure	3
Fo	Excavate foundations	4
W	Build walls	3
Pb	Install plumbing	2
R	Construct roof	3
Fl	Lay floor	2
E	Fit electrics	2
WD	Install windows and doors	1
Deco	Decorate	5

(i) Show the immediate predecessors for each activity. **[2]**

(ii) Perform a forward pass and a backward pass to find the early time and the late time for each event. **[4]**

(iii) Give the critical activities, the project duration, and the total float for each activity. **[4]**

(iv) The activity network includes one dummy activity. Explain why this dummy activity is needed. **[2]**

Whilst the foundations are being dug the customer negotiates the installation of a decorative corbel. This will take one day. It must be done after the walls have been built, and before the roof is constructed. The windows and doors cannot be installed until it is completed. It will not have any effect on the construction of the floor.

(v) Redraw the activity network incorporating this extra activity. **[3]**

(vi) Find the revised critical activities and the revised project duration. **[1]**

6 The table shows the distances in miles, where direct rail connections are possible, between 11 cities in a country. The government is proposing to construct a high-speed rail network to connect the cities.

	P	S	F	Ln	Br	Nr	Bm	Ld	Nc	Lv	M
P	–	150	–	240	125	–	–	–	–	–	–
S	150	–	150	80	105	–	135	–	–	–	–
F	–	150	–	80	–	–	–	–	–	–	–
Ln	240	80	80	–	120	115	120	–	–	–	–
Br	125	105	–	120	–	230	90	–	–	–	–
Nr	–	–	–	115	230	–	160	175	255	–	–
Bm	–	135	–	120	90	160	–	120	–	–	90
Ld	–	–	–	–	–	175	120	–	210	100	90
Nc	–	–	–	–	–	255	–	210	–	175	–
Lv	–	–	–	–	–	–	–	100	175	–	35
M	–	–	–	–	–	–	90	90	–	35	–

(i) Use the tabular form of Prim's algorithm, starting at vertex P, to find a minimum connector for the network. Draw your minimum connector and give its total length. **[6]**

(ii) Give one advantage and two disadvantages of constructing a rail network using only the arcs of a minimum connector. **[3]**

(iii) Use Dijkstra's algorithm on the diagram in the Printed Answer Book, to find the shortest route and distance from P to Nr in the original network. **[6]**

(iv) Give the shortest distance from P to Nr using only arcs in your minimum connector. **[1]**

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ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI)

4771

Decision Mathematics 1

PRINTED ANSWER BOOK

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OCR supplied materials:
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- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Wednesday 22 June 2011
Morning

Duration: 1 hour 30 minutes

Candidate forename		Candidate surname	

Centre number						Candidate number				

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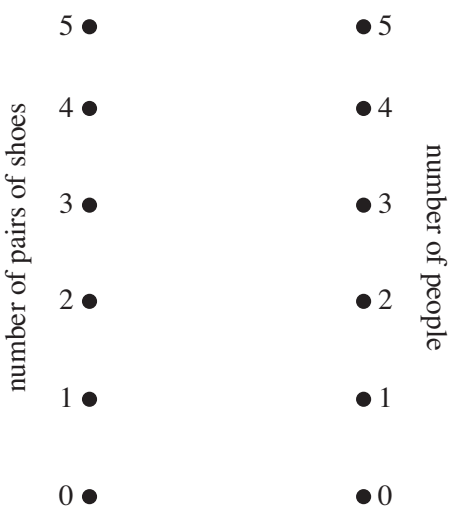
DC (LEO/DJ) 18044/6

Section A (24 marks)

1 (i)



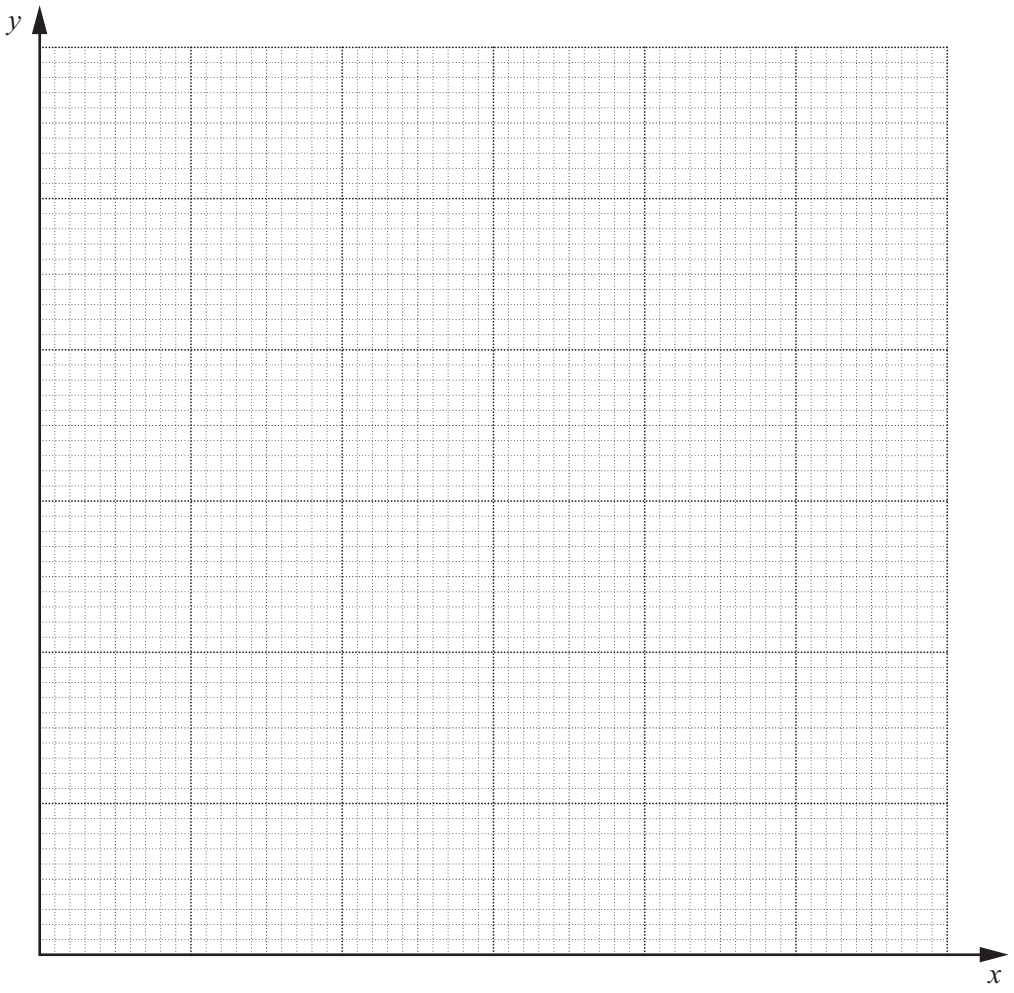
1 (ii)

1 (iii)

1 (iv)

1 (v)

2 (i)



2 (ii)

3 (i)

x	1	2	3
Probability$(X = x)$	$\frac{1}{2}$	$\frac{1}{6}$	$\frac{1}{3}$

3 (ii)

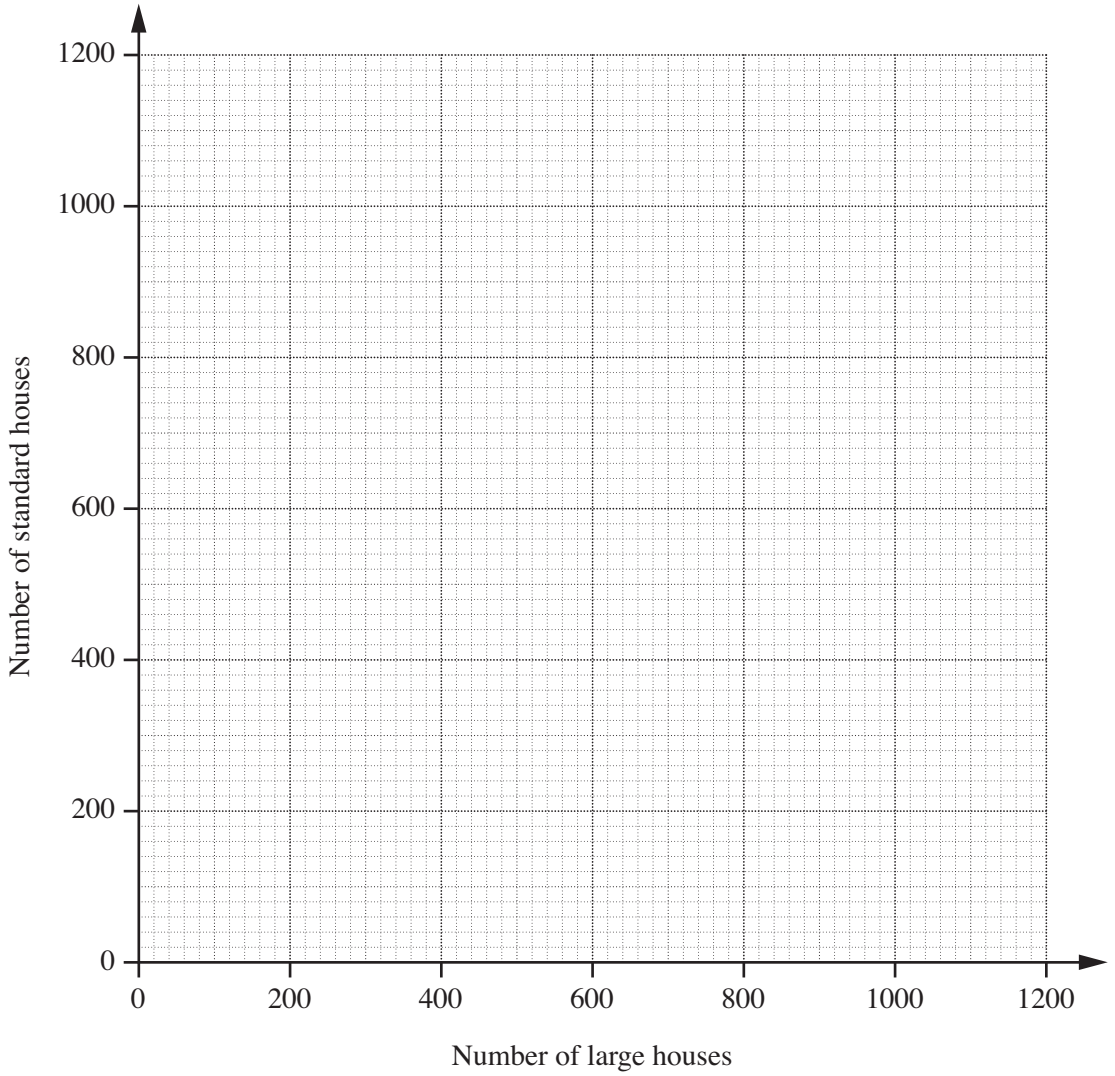
y	1	2	3
Probability$(Y = y)$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{4}$

3 (iii)	
	PLEASE DO NOT WRITE ON THIS SPACE

Section B (48 marks)

4 (i)

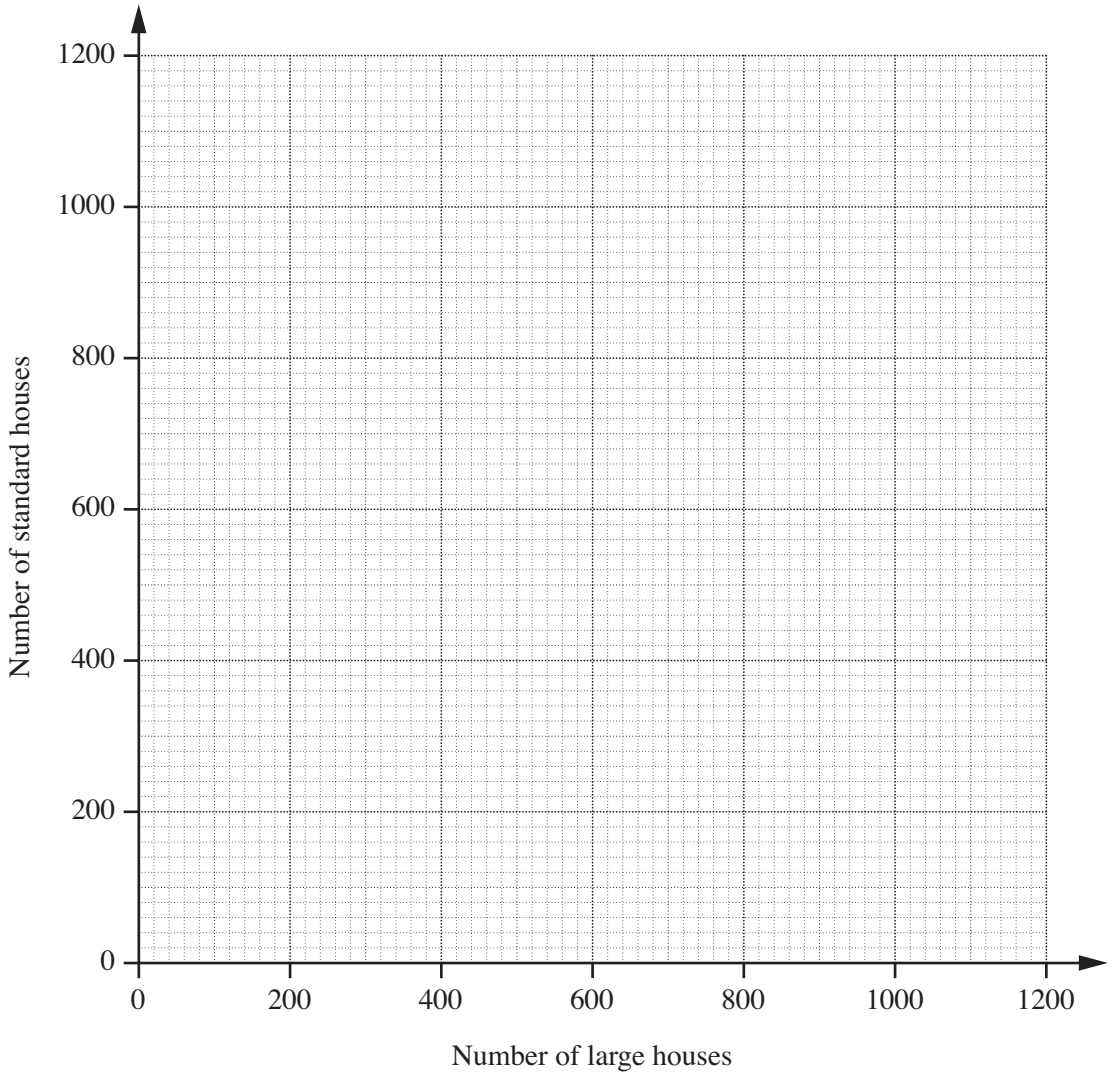
4 (ii)



4 (iii)

4 (iv)

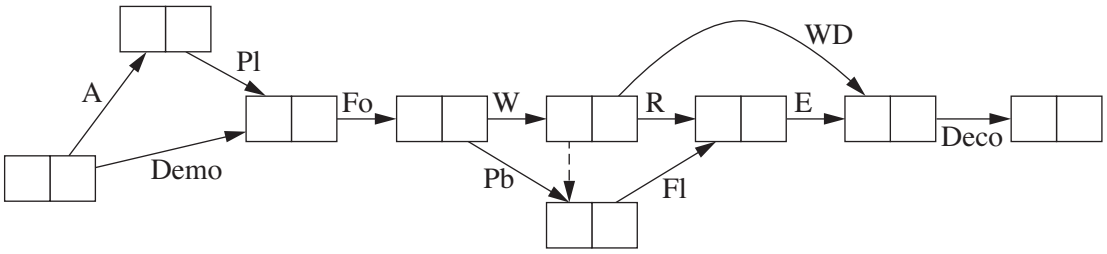
4 (ii) **SPARE COPY OF GRAPH PAPER**



5 (i)

Activity	Immediate predecessor(s)
A	
Pl	
Demo	
Fo	
W	
Pb	
R	
Fl	
E	
WD	
Deco	

5 (ii)



5 (iii)

task: A Pl Demo Fo W Pb R Fl E WD Deco

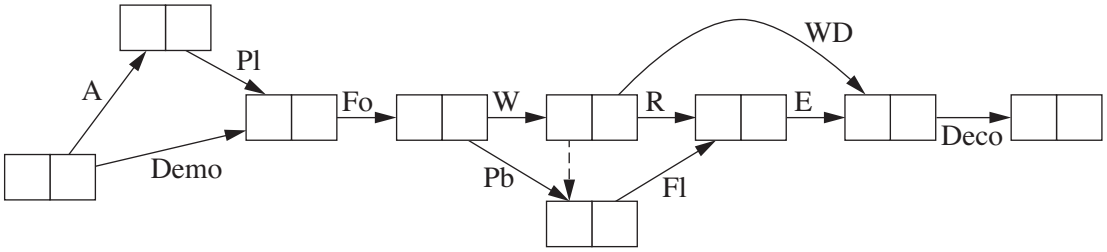
float:

5 (iv)

5 (v)

5 (vi)

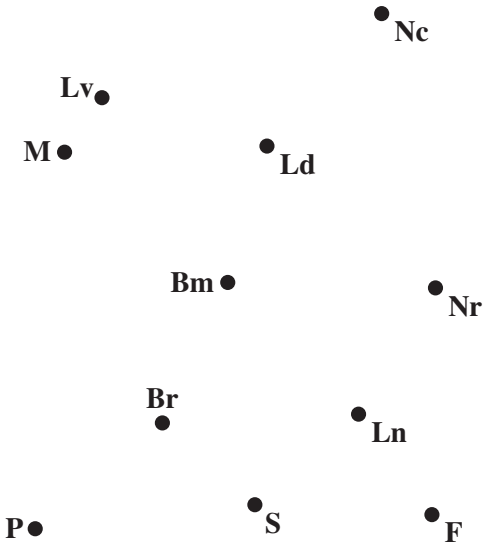
5 (ii) **SPARE COPY OF ACTIVITY NETWORK**



6 (i)

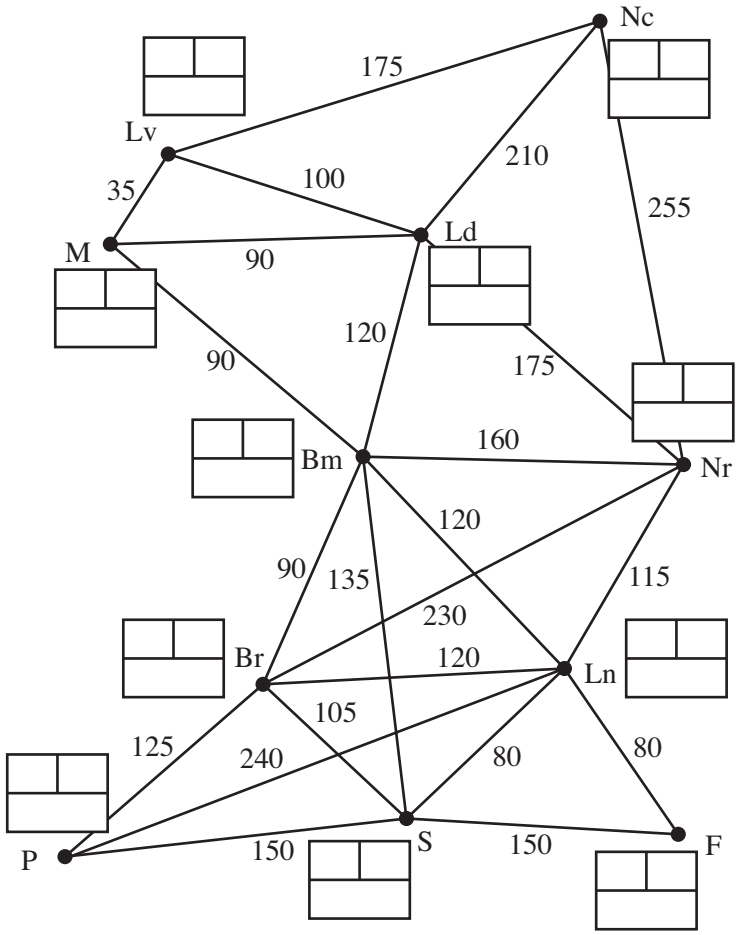
	P	S	F	Ln	Br	Nr	Bm	Ld	Nc	Lv	M
P	–	150	–	240	125	–	–	–	–	–	–
S	150	–	150	80	105	–	135	–	–	–	–
F	–	150	–	80	–	–	–	–	–	–	–
Ln	240	80	80	–	120	115	120	–	–	–	–
Br	125	105	–	120	–	230	90	–	–	–	–
Nr	–	–	–	115	230	–	160	175	255	–	–
Bm	–	135	–	120	90	160	–	120	–	–	90
Ld	–	–	–	–	–	175	120	–	210	100	90
Nc	–	–	–	–	–	255	–	210	–	175	–
Lv	–	–	–	–	–	–	–	100	175	–	35
M	–	–	–	–	–	–	90	90	–	35	–

Min connector



6 (ii)

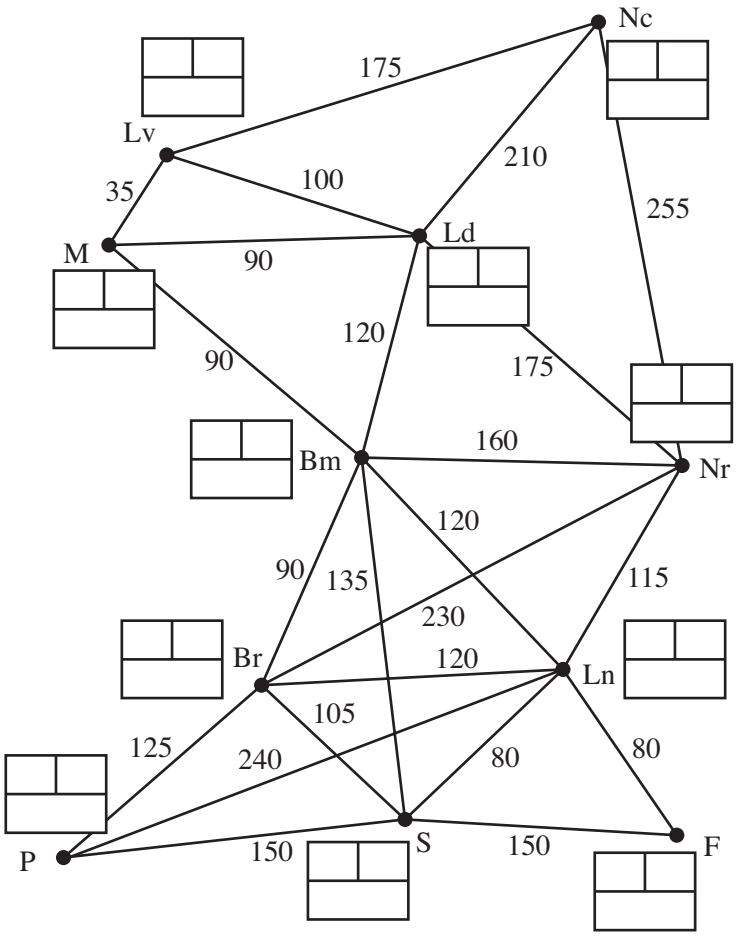
6 (iii)



THERE IS A SPARE COPY OF THIS NETWORK ON PAGE 12.

6 (iv)

6 (iii) **SPARE COPY OF NETWORK**



OCR
RECOGNISING ACHIEVEMENT

GCE

Mathematics (MEI)

Advanced Subsidiary GCE

Unit **4771:** Decision Mathematics 1

Mark Scheme for June 2011

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of pupils of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, OCR Nationals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support which keep pace with the changing needs of today's society.

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by Examiners. It does not indicate the details of the discussions which took place at an Examiners' meeting before marking commenced.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Any enquiries about publications should be addressed to:

OCR Publications
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Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

Subject-specific Marking Instructions for GCE Mathematics (MEI) Statistics strand

a Annotations should be used whenever appropriate during your marking.

The A, M and B annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks. It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

For subsequent marking you must make it clear how you have arrived at the mark you have awarded.

b An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme is designed to assist in marking incorrect solutions. Correct *solutions* leading to correct answers are awarded full marks but work must not be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working must always be looked at and anything unfamiliar must be investigated thoroughly.

Correct but unfamiliar or unexpected methods are often signalled by a correct result following an *apparently* incorrect method. Such work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, award marks according to the spirit of the basic scheme; if you are in any doubt whatsoever (especially if several marks or candidates are involved) you should contact your Team Leader.

c The following types of marks are available.

M
A suitable method has been selected and *applied* in a manner which shows that the method is essentially understood. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, eg by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M mark may be specified.

A
Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

B
Mark for a correct result or statement independent of Method marks.

E
A given result is to be established or a result has to be explained. This usually requires more working or explanation than the establishment of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, eg wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where a candidate passes through the correct answer as part of a wrong argument.

d When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation 'dep *' is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, when two or more steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.

e The abbreviation ft implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A and B marks are given for correct work only — differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable. In such cases, exactly what is acceptable will be detailed in the mark scheme rationale. If this is not the case please consult your Team Leader.

Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will often be 'follow through'. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not shown within the image zone. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-question.

f Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise.

Candidates are expected to give numerical answers to an appropriate degree of accuracy. 3 significant figures may often be the norm for this, but this always needs to be considered in the context of the problem in hand. For example, in quoting probabilities from Normal tables, we generally expect *some* evidence of interpolation and so quotation to 4 decimal places will often be appropriate. But even this does not always apply – quotations of the standard critical points for significance tests such as 1.96, 1.645, 2.576 (maybe even 2.58 – but not 2.57) will commonly suffice, especially if the calculated value of a test statistic is nowhere near any of these values. Sensible discretion *must* be exercised in such cases.

Discretion must also be exercised in the case of small variations in the degree of accuracy to which an answer is given. For example, if 3 significant figures are expected (either because of an explicit instruction or because the general context of a problem demands it) but only 2 are given, loss of an accuracy ("A") mark is likely to be appropriate; but if 4 significant figures are given, this should not normally be penalised. Likewise, answers which are slightly deviant from what is expected in a very minor manner (for example a Normal probability given, after an attempt at interpolation, as 0.6418 whereas 0.6417 was expected) should not be penalised. However, answers which are *grossly* over- or under-specified should normally result in the loss of a mark. This includes cases such as, for example, insistence that the value of a test statistic is (say) 2.128888446667 merely because that is the value that happened to come off the candidate's calculator. Note that this applies to answers that are given as final stages of calculations; intermediate working should usually be carried out, and quoted, to a greater degree of accuracy to avoid the danger of premature approximation.

The situation regarding any particular cases where the accuracy of the answer may be a marking issue should be detailed in the mark scheme rationale. If in doubt, contact your Team Leader.

g Rules for replaced work

If a candidate attempts a question more than once, and indicates which attempt he/she wishes to be marked, then examiners should do as the candidate requests.

If there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to be the last (complete) attempt and ignore the others.

NB Follow these maths-specific instructions rather than those in the assessor handbook.

h Genuine misreading (of numbers or symbols, occasionally even of text) occurs. If this results in the object and/or difficulty of the question being considerably changed, it is likely that all the marks for that question, or section of the question, will be lost. However, misreads are often such that the object and/or difficulty remain substantially unaltered; these cases are considered below.

The simple rule is that *all* method ("M") marks [and of course all independent ("B") marks] remain accessible but at least some accuracy ("A") marks do not. It is difficult to legislate in an overall sense beyond this global statement because misreads, even when the object and/or difficulty remains unchanged, can vary greatly in their effects. For example, a misread of 1.02 as 10.2 (perhaps as a quoted value of a sample mean) may well be catastrophic; whereas a misread of 1.6748 as 1.6746 may have so slight an effect as to be almost unnoticeable in the candidate's work.

A misread should normally attract *some* penalty, though this would often be only 1 mark and should rarely if ever be more than 2. Commonly in sections of questions where there is a numerical answer either at the end of the section or to be obtained and commented on (eg the value of a test statistic), this answer will have an "A" mark that may actually be designated as "cao" [correct answer only]. This should be interpreted *strictly* – if the misread has led to failure to obtain this value, then this "A" mark must be withheld even if all method marks have been earned. It will also often be the case that such a mark is implicitly "cao" even if not explicitly designated as such.

On the other hand, we commonly allow "fresh starts" within a question or part of question. For example, a follow-through of the candidate's value of a test statistic is generally allowed (and often explicitly stated as such within the marking scheme), so that the candidate may exhibit knowledge of how to compare it with a critical value and draw conclusions. Such "fresh starts" are not affected by any earlier misreads.

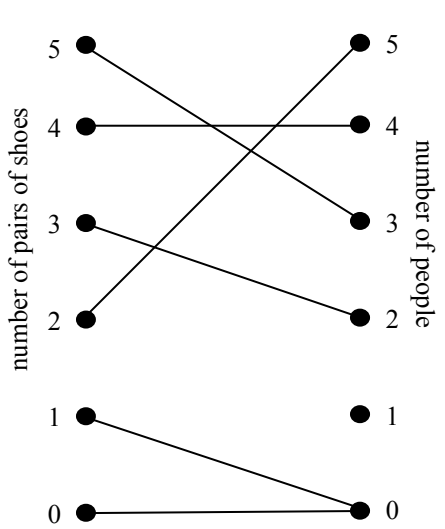
A misread may be of a symbol rather than a number – for example, an algebraic symbol in a mathematical expression. Such misreads are more likely to bring about a considerable change in the object and/or difficulty of the question; but, if they do not, they should be treated as far as possible in the same way as numerical misreads, *mutatis mutandis*. This also applied to misreads of text, which are fairly rare but can cause major problems in fair marking.

The situation regarding any particular cases that arise while you are marking for which you feel you need detailed guidance should be discussed with your Team Leader.

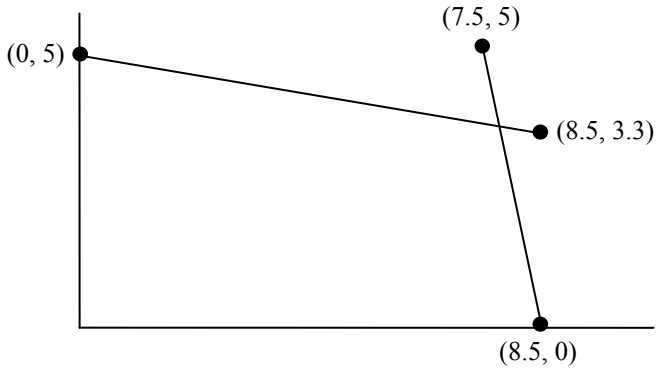
Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

4771, June 2011, Markscheme

1.

(i) 	B1 3 to 4 deleted B1 1 to 4 deleted B1 4 to 4 added	-1 for each arc in error
(ii) 14	B1	
(iii) 47	M1 A1 cao	Award method mark if answer correct, or if wrong but with a sum of products shown.
(iv) (0, 0) and (1, 0)	B1	Award only if correct **points** are specified in some way.
(v) Explanation should recognise that a line is a set of points − not appropriate in this context.	B1	e.g. "Intermediate points have no meaning." e.g. "Can't have one and a half pairs of shoes." (sic)

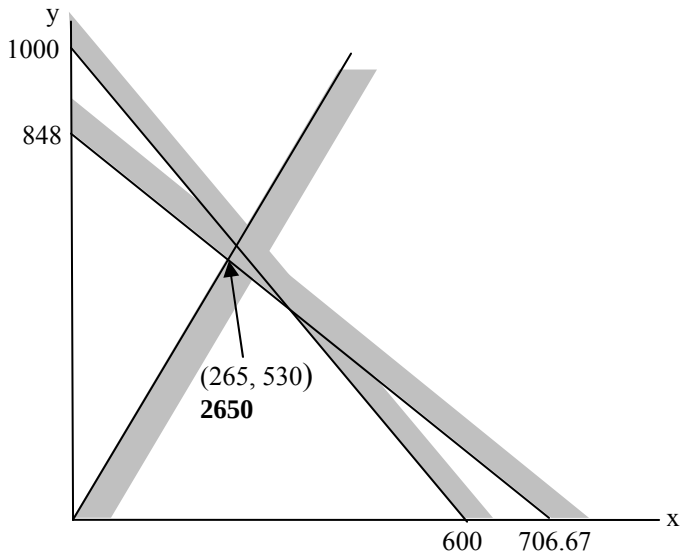
2.

(i) $X = \min(25, 8.5) = 8.5$ or equivalent	B1	cao	OK if only seen once or more on graph
$Y = \min(5, 42.5) = 5$ oe	B1	cao	OK if only seen once or more on graph
$X^* = (85–10)/10 = 7.5$ oe	B1	cao	OK if only seen on graph
$Y^* = (25–8.5)/5 = 3.3$ oe	B1	cao	OK if only seen on graph
	B1	allow ft	sensibly scaled for their X and Y e.g. disallow if either of the lines in the question could intersect both axes.
	B1	cao	lines - can extend to beyond segment
	B1	cao	condone minor errors in plotting (e.g. 8.5 plotted at 9)
(ii) Avoids tiny feasible regions.	B1		need comment on size of region

3.

(i) e.g. 1, 2, 3 → 1 4 → 2 5, 6 → 3	M1 A1 A1	function with domain {1,2,3,4,5,6} and range {1,2,3} (special cases are possible – if correct!) proportions 3:2:1 all OK
(ii) e.g. 1, 2 → 1 3 → 2 4 → 3 (5, 6 → reject and throw again)	M1 reject some A1 reject two A1 rest	(Special cases are possible – if correct! e.g. allow throwing die twice and allocating correct proportions of 36.)
(iii) non uniform allows 100	B1 B1	"101 values" OK no credit for, e.g. "3 is not a two-digit number"

4.

(i)	e.g. x = number of large houses y = number of standard houses	M1 A1	M1 for variables for large and for standard A1 for "number"
	land: 200x + 120y <= 120000 oe cash: 60x + 50y <= 42400 oe market: x <= 0.5y oe	B1 B1 B1	use "isw" for incorrect simplifications -1 once only for any " < "
(ii)		B1 line 1, allow ft B1 line 2, allow ft B1 line 3, allow ft B1 feasible region	for instance, if x <= 2y in part (i), then allow correct graph of x <= 0.5y or ft graph of x <= 2y plotting tolerance on axis intersection points – within correct small square must consider 3 lines ft if region includes y-axis interval from origin upwards allow any clear indication of feasible region ignore any indication(s) of boundary lines included or excluded
(iii)	intersection of y=2x and 6x+5y=4240, (265, 530) 2650	M1 correct point, cao A1	identification only - coordinates not required here their 4x+3y from (260-280, 520-540)
(iv)	their 60x + 50y <= 45000 or line from their (0, 900) to (750, 0)	B1 ft	can be implied from final M1 working
	Best point is at the intersection of the land constraint and the new cash constraint, and not on y=2x	M1 comparison of two (or more) points A1	not just ringing points their identified best point is not on y=2x or an axis
	(214, 643) 2785	M1 correct point, cao A1	identification, coordinates not required here bedrooms - their 4x+3y from (200-220, 620-660)

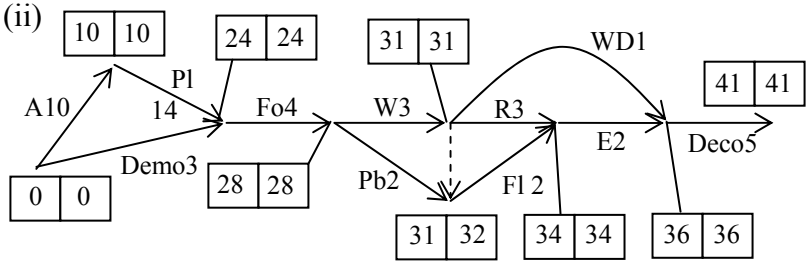
5.

(i)

Activity	Immediate predecessors
A	–
Pl	A
Demo	–
Fo	Pl; Demo
W	Fo
Pb	Fo
R	W
Fl	Pb; W
E	R; Fl
WD	W
Deco	WD; E

M1 Fl correct
A1 rest

(ii)



M1 at least one correct nontrivial join
A1 forward pass

M1 at least one correct nontrivial burst
A1 backward pass

excluding start node

(iii) critical activities: A; Pl; Fo; W; R; E; Deco

B1 cao

project duration = 41 days

B1 cao

act	A	Pl	Dm	Fo	W	Pb	R	Fl	E	WD	Dc
float	0	0	21	0	0	2	0	1	0	4	0

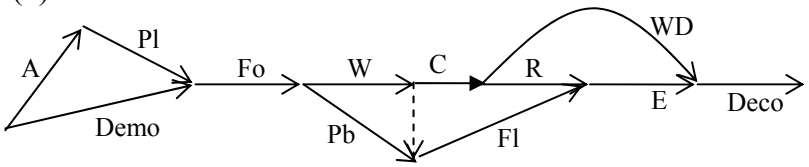
B1 A, Pl, Dm, Fo, W
B1 rest

cao
cao – most see zeros, dashes or empty spaces won't do

(iv) Fl has both W and Pb as immediate predecessors.
R and WD have only W as immediate predecessor.

B1
B1 one of R/WD

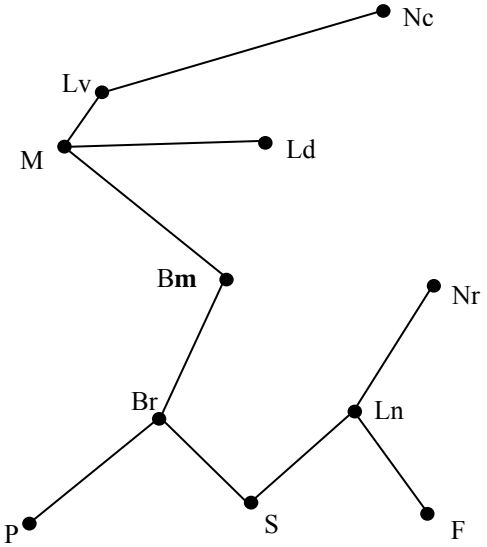
SC1 for a convincing but not specific answer, e.g. "A dummy is needed to cater for both joint and separate precedences".

(v)  	M1 C between W and R A1 Fl + dummy OK A1 WD OK	
(vi) new duration = 42 days critical activities: A; Pl; Fo; W; C; R; E; Deco	B1 cao	both needed

6.

(i)

	1	7	9	8	2	10	3	6	11	5	4
	P	S	F	Ln	Br	Nr	Bm	Ld	Nc	Lv	M
P	–	150	–	240	125	–	–	–	–	–	–
S	150	–	150	80	105	–	135	–	–	–	–
F	–	150	–	80	–	–	–	–	–	–	–
Ln	240	80	80	–	120	115	120	–	–	–	–
Br	125	105	–	120	–	230	90	–	–	–	–
Nr	–	–	–	115	230	–	160	175	255	–	–
Bm	–	135	–	120	90	160	–	120	–	–	90
Ld	–	–	–	–	–	175	120	–	210	100	90
Nc	–	–	–	–	–	255	–	210	–	175	–
Lv	–	–	–	–	–	–	–	100	175	–	35
M	–	–	–	–	–	–	90	90	–	35	–



Length = 985 miles

M1 tabular Prim — 125 in P column and 90 in Br column ringed, with both rows crossed

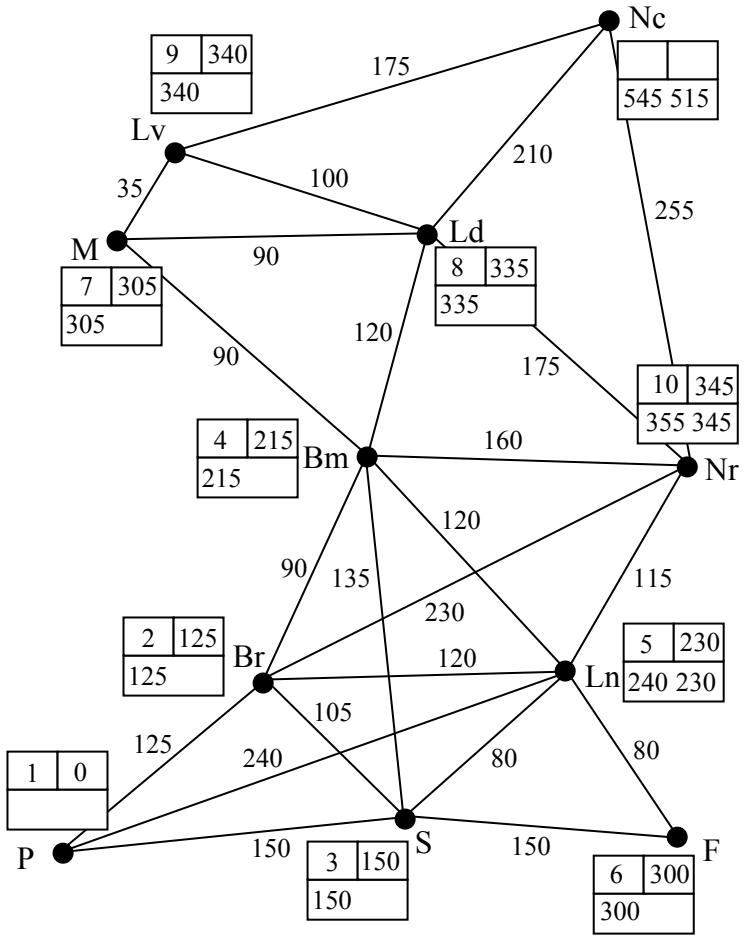
A2 choosings — all circles in correct place; -1 each error (watch for one error making two changes to a row)

A1 crossings — all rows crossed out except, possibly, Nc row.

accept convincing transpose

B1 cao

B1 cao

(ii)	Advantage: shortest length of track Disadvantage: tree, no redundancy ≡ fragility (breakdown et al) Disadvantage: some journeys are not shortest paths	B1 cao B1 B1	allow cost minimisation could say "no cycles" disallow comments relating to direct connectivity, or relating to more stops "longer journeys" or "takes longer" allowed allow "min connector arcs may be more expensive" oe don't allow two marks for the same point described differently. e.g. longer journeys/more time/more upkeep
(iii)		M1 Dijkstra A1 working values B1 labels B1 order of labelling	correct working values (no extras) at Ln and Nr, and working values only superseded at Ln and Nr (ignore Nc for this M) (need to check Nc here)
	Route: P S Ln Nr Distance: 345 miles	B1 cao B1 cao	
(iv)	Distance by min connector = 425 miles	B1 ft their mc	

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4771: Decision Mathematics 1

General Comments

A feature of this year's paper was the frequency of scripts on which good solutions to some questions were accompanied by poor answers to others.

Questions 1(v), 2, 3 and 6(ii) were found to be the most challenging.

Clarity of thought and good literacy skills are vital in producing well-argued answers for questions requiring an explanation.

Comments on Individual Questions

1 **Graph Theory**

Most candidates answered parts (i), (ii) and (iii) correctly. Both points were needed for the mark in (iv). Some did not understand what was meant by a "point".

Many answers of a vaguely statistical nature were seen in (v), with references to a "lack of correlation" et al.

2 **Algorithms**

Most candidates could compute *c/a* and *f/d* for the given values, but many then failed to identify the minimum of the two.

Very few candidates indeed scored the single mark in part (ii). For it to be awarded there had to be reference to the size of the feasible region when graphed.

3 **Simulation**

In each paper it is the turn of a part B topic to appear, in reduced form, in part A. This time it was the turn of simulation.

Whereas usually the majority of candidates can generally define appropriate rules for simulating a random variable, in this question the majority could not.

A common error in part (ii) was a rule which mapped die scores 1, 2 and 3 to the output 1, score 4 to output 2, score 5 to output 6, and rejected score 6. Many candidates gave a rule using 2-digit random numbers and a considerable number made no attempt at the question.

Common incorrect criticisms of John's methodology in (iii) were:

- because he subtracted one from the result on the die, there was no chance of his procedure producing a 6.
- a throw would be wasted if it produced a 1, since when John subtracted 1 from it there would be nothing left.

Very few marks indeed were awarded here.

Mention must be made of the very many candidates who also criticised John for not repeating his simulation often enough. They were determined to earn the "repetition" mark, even though John was not doing a simulation, so that there was no such mark to earn.

4 **LP**

The majority of candidates made a decent attempt at the modelling in part (i). Note that examiners were required to be very particular in requiring definitions to refer to "the number of", since one of the root causes of difficulties in algebraic understanding is a failure to realise that letters stand for numbers, and not objects.

In part (ii), and subsequently, the mark scheme was generous to those confusing 2x and x/2. Candidates can avoid such errors by checking specific values – do they satisfy the question/do they satisfy the inequality?

There were only 2 marks for part (iii), and about 50% of candidates were successful with it.

Part (iv) was more difficult with a little modelling, followed by the need for a comparison, and then a slightly tricky identification of the best point.

This was not an easy question, and many performances on it were good or acceptable.

5 **CPA**

As in January, most candidates were able to give immediate predecessors in part (i). Part (ii), the forward and backward passes, was also answered well. Part (iii) was a mixed bag, with critical activities, duration and float, and again answers were generally acceptable.

Part (iv) was reckoned to be a difficult explanation, and so it proved. Part (v) was found to be relatively easy. Few could marshal both critical activities and the revised duration for the mark in (vi).

6 **Networks**

Prim in tabular form caught out a good proportion of candidates. Not many candidates could produce the correct minimum connector for this small network. One would have expected it to be correct by inspection, and to be used to check the operation of the algorithm.

Some explanations in part (ii) revealed a confusion between direct connectivity and shortest routes. Typically candidates would refer to the minimum connector not using particular direct connections, when there were no such direct connections to use! Those candidates meant shortest routes. Of course, that was the point of the question, but few seemed to notice it.

As in part (i) one would have expected most candidates to have produced the required shortest route and distance in part (iii), independently of their work on Dijkstra. That was not the case – very few got it right.

In part (iv), and in other parts of this question, arithmetic errors abounded.

GCE Mathematics (MEI)

			Max Mark	a	b	c	d	e	u
4751/01	(C1) MEI Introduction to Advanced Mathematics	Raw	72	55	49	43	37	32	0
		UMS	100	80	70	60	50	40	0
4752/01	(C2) MEI Concepts for Advanced Mathematics	Raw	72	53	46	39	33	27	0
		UMS	100	80	70	60	50	40	0
4753/01	(C3) MEI Methods for Advanced Mathematics with Coursework: Written Paper	Raw	72	54	48	42	36	29	0
4753/02	(C3) MEI Methods for Advanced Mathematics with Coursework: Coursework	Raw	18	15	13	11	9	8	0
4753/82	(C3) MEI Methods for Advanced Mathematics with Coursework: Carried Forward Coursework Mark	Raw	18	15	13	11	9	8	0
4753	(C3) MEI Methods for Advanced Mathematics with Coursework	UMS	100	80	70	60	50	40	0
4754/01	(C4) MEI Applications of Advanced Mathematics	Raw	90	63	56	50	44	38	0
		UMS	100	80	70	60	50	40	0
4755/01	(FP1) MEI Further Concepts for Advanced Mathematics	Raw	72	59	52	45	39	33	0
		UMS	100	80	70	60	50	40	0
4756/01	(FP2) MEI Further Methods for Advanced Mathematics	Raw	72	55	48	41	34	27	0
		UMS	100	80	70	60	50	40	0
4757/01	(FP3) MEI Further Applications of Advanced Mathematics	Raw	72	55	48	42	36	30	0
		UMS	100	80	70	60	50	40	0
4758/01	(DE) MEI Differential Equations with Coursework: Written Paper	Raw	72	63	57	51	45	39	0
4758/02	(DE) MEI Differential Equations with Coursework: Coursework	Raw	18	15	13	11	9	8	0
4758/82	(DE) MEI Differential Equations with Coursework: Carried Forward Coursework Mark	Raw	18	15	13	11	9	8	0
4758	(DE) MEI Differential Equations with Coursework	UMS	100	80	70	60	50	40	0
4761/01	(M1) MEI Mechanics 1	Raw	72	60	52	44	36	28	0
		UMS	100	80	70	60	50	40	0
4762/01	(M2) MEI Mechanics 2	Raw	72	64	57	51	45	39	0
		UMS	100	80	70	60	50	40	0
4763/01	(M3) MEI Mechanics 3	Raw	72	59	51	43	35	27	0
		UMS	100	80	70	60	50	40	0
4764/01	(M4) MEI Mechanics 4	Raw	72	54	47	40	33	26	0
		UMS	100	80	70	60	50	40	0
4766/01	(S1) MEI Statistics 1	Raw	72	53	45	38	31	24	0
		UMS	100	80	70	60	50	40	0
4767/01	(S2) MEI Statistics 2	Raw	72	60	53	46	39	33	0
		UMS	100	80	70	60	50	40	0
4768/01	(S3) MEI Statistics 3	Raw	72	56	49	42	35	28	0
		UMS	100	80	70	60	50	40	0
4769/01	(S4) MEI Statistics 4	Raw	72	56	49	42	35	28	0
		UMS	100	80	70	60	50	40	0
4771/01	(D1) MEI Decision Mathematics 1	Raw	72	51	45	39	33	27	0
		UMS	100	80	70	60	50	40	0
4772/01	(D2) MEI Decision Mathematics 2	Raw	72	58	53	48	43	39	0
		UMS	100	80	70	60	50	40	0
4773/01	(DC) MEI Decision Mathematics Computation	Raw	72	46	40	34	29	24	0
		UMS	100	80	70	60	50	40	0
4776/01	(NM) MEI Numerical Methods with Coursework: Written Paper	Raw	72	62	55	49	43	36	0
4776/02	(NM) MEI Numerical Methods with Coursework: Coursework	Raw	18	14	12	10	8	7	0
4776/82	(NM) MEI Numerical Methods with Coursework: Carried Forward Coursework Mark	Raw	18	14	12	10	8	7	0
4776	(NM) MEI Numerical Methods with Coursework	UMS	100	80	70	60	50	40	0
4777/01	(NC) MEI Numerical Computation	Raw	72	55	47	39	32	25	0
		UMS	100	80	70	60	50	40	0