

Mathematics Methods Unit 4



Calculator Assumed
Random Sampling and Distributions

Total Marks: 45
Time: 45 minutes
Your Score: / 45

Question One: [2, 2, 3 = 10 marks] CA

(b) A class of Year 8 students are asked to complete a compulsory survey for the following question: "Should the School reduce the lunch hour to 30 minutes?"

(d) Over the course of a Saturday, shopkeepers in the city central shopping mall were approached and asked: "Do you think the US response to the September 11 attacks was appropriate?"

(c) A random sample of residents in a particular suburb were asked: "Do you prefer Hungry Jacks' over other competitors?"

(a) During an episode of The Biggest Loser, a weight loss show, the winning audience were asked to SMS in either Yes or No to the following question: "Do you eat fast food more than once a week?"

Question Two:[5 marks] CA

At the office of Dunder/Mifflin, a company selling stationery supplies, there are the following number of employees:

- 1 Manager
- 7 Sales Representatives
- 2 Office Assistants
- 3 Accountants
- 13 Warehouse employees

The Manager, Michael Scott, wants the Human Resources representative to survey 5 staff on the success of their Positivity Day.

If the Human Resources representative does this proportionally, how many of each staff group should he select?

Two digit random numbers have been created using an excel spreadsheet. A screen shot of these numbers is shown below.

Question Three: $[3, 3] = 6 \text{ marks}$

Mathematics Methods Unit 4

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
48	84	14	34	52	25	75	15	49	15	67	22	46	92	31				
52	84	38	46	64	64	68	20	98	46	81	47	66	99	48	19			
56	33	41	92															
60	30	21	47	19	79	17	81	64	73	27	75	31	21	24	74			
64	73	88	82	26	41	57	93	23	83	65	63	31	34	49	48			
68	13	41	92	13	46	32	33	18	54	97	67	60	60	49	19			
72	13	45	15	47	18	16	93	97	70	77	66	38	72	97	39			
76	74	66	64	33	24	16	48	34	93	25	75	86	85	50	97			
80	86	94	10	87	22	72	72	95	56	47	55	72	42	45	69			
84	34	12	49	12	72	41	11	14	22	64	33	67	50	67	56	45		
88	64	91	92	87	22	73	22	17	87	18	43	96	83	76	83	59		
92	61	91	92	87	22	73	22	17	14	71	18	43	96	83	76	83		
96	52	99	10	99	32	94	83	30	86	30	25	25	35	46	34			
100	52	95	95	53	88	11	97	42	15	46	52	29	43	74	76			
104	58	91	92	62	68	57	58	92	89	23	66	82	83	56	60			
108	61	91	92	67	85	10	24	21	25	24	39	10	56	97				
112	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
116	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
120	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
124	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
128	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
132	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
136	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
140	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
144	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
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152	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
156	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
160	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
164	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
168	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
172	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
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184	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
188	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
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244	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
248	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
252	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
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272	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
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316	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
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324	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
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348	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
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356	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
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372	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
376	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
380	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
384	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
388	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
392	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
396	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
400	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
404	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
408	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
412	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
416	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
420	64	91	92	67	85	10	24	21	25	24	39	10	56	97				
424	64	91	92	67	85	10	24	21	25	24	39	10	56	97				

(a) Starting in column F and row 5, collect a systematic sample of size 8 of numbers between 74 and 150 inclusive.

(b) Landline phone numbers in Australia begin with an area code, followed by a 9 and then 8 digits. Collect a sample of 10.

(b) Standard phone numbers in Australia begin with area code, followed by 9 and then followed by 7 digits. Starting in column K and row 15, collect a sample of 10 phone numbers (ignoring the area codes).

3

Question Six: [1, 2, 1 = 6 marks] CA

(a) What proportion of items do you expect to lie within two standard deviations of the

(b) Calculate the mean and standard deviation for this sample.

(d) If a random sample of 100 items had been created instead, what would you notice about the variability of the mean and standard deviation between the larger sample

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Quasiprimitive: $[1, 2, 2, 1 - 6 \text{ marks}]$

Question Four: [2, 2, 2, 3 = 9 marks] CA

At a particular bus stop during morning peak hour, the waiting time for the next bus is between 0 seconds and 300 minutes.

- (a) Define the random variable that would model this situation.

- (b) Determine the mean and standard deviation for this distribution.

During peak hour on a Monday morning, random samples of waiting times were observed for this bus stop. These times are shown below.

	B	C
0.29	1.41	
0.44	1.45	
0.96	0.05	
0.26	1.24	
1.58	1.54	
3.92	1.01	
3.88	2.08	
3.90	0.16	
0.89	2.80	
4.77	3.28	

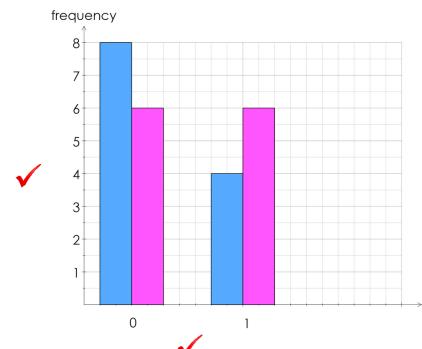
- (c) Calculate the mean and standard deviation for the above sample.

- (b) Calculate the mean and standard deviation of the second sample, given in list 2.

$$\mu = 0.5 \quad \checkmark$$

$$\sigma = 0.5 \quad \checkmark$$

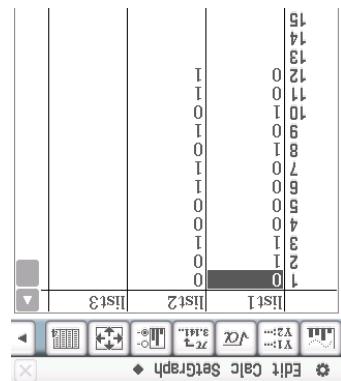
- (c) Construct a side-by-side column graph of the sample results.



- (d) Hence or otherwise compare and contrast the distributions.

The second sample has a perfectly symmetrical distribution while the first sample is slightly positively skewed. ✓ ✓

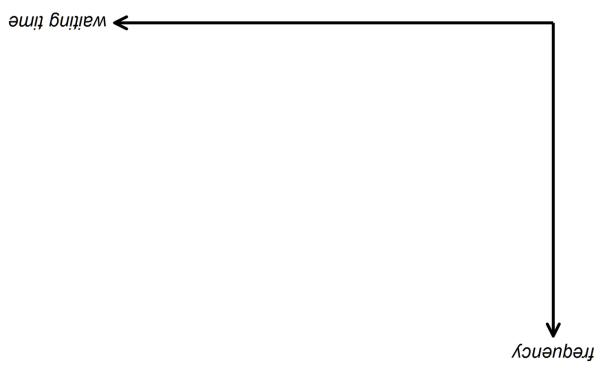
- (a) Calculate the mean and standard deviation of the first sample, given in list 1.



Two random samples of 12 trials is given below:

A Bernoulli trial is such that the probability of success is 0.4.

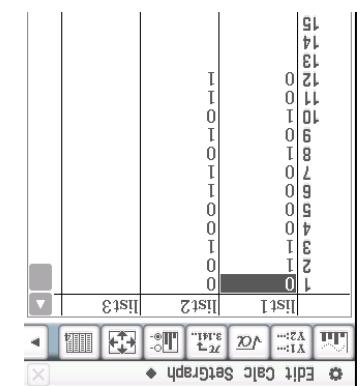
Question Five: [2, 2, 3, 2 = 9 marks] CA



- (d) By grouping the data appropriately, draw a graph of the sample distribution on the axes below.

Mathematics Methods Unit 4

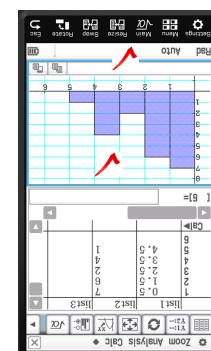
- (a) Calculate the mean and standard deviation of the first sample, given in list 1.



Two random samples of 12 trials is given below:

A Bernoulli trial is such that the probability of success is 0.4.

Question Five: [2, 2, 3, 2 = 9 marks] CA



- (d) By grouping the data appropriately, draw a graph of the sample distribution on the axes below.

Mathematics Methods Unit 4

$$\sigma = 0.47$$

$$\mu = 0.33$$

- (b) Calculate the mean and standard deviation of the second sample, given in list 2.

- (c) Construct a side-by-side column graph of the sample results.



- (d) Hence or otherwise compare and contrast the distributions.

Question Four: [2, 2, 2, 3 = 9 marks] CA

At a particular bus stop during morning peak hour, the waiting time for the next bus is between 0 seconds and 300 seconds.

- (a) Define the random variable that would model this situation.

$$P(X = x) = \begin{cases} \frac{1}{300}; 0 \leq x \leq 300 \\ 0 \text{ otherwise} \end{cases}$$

- (b) Determine the mean and standard deviation for this distribution.

$$\mu = 150 \text{ sec}$$

$$\sigma = \sqrt{\frac{150^2}{12}} = 43.3 \text{ sec}$$

During peak hour on a Monday morning, random samples of waiting times were observed for this bus stop. These times are shown below.

	B	C
0.29	1.41	
0.44	1.45	
0.96	0.05	
0.26	1.24	
1.58	1.54	
3.92	1.01	
3.88	2.08	
3.90	0.16	
0.89	2.80	
4.77	3.28	

- (c) Calculate the mean and standard deviation for the above sample.

$$\mu = 1.8 \text{ min}$$

$$\sigma = 1.4 \text{ min}$$

If a random sample of 100 items had been created instead, what would you notice about the variability of the mean and standard deviation between the larger sample and the one given above?

(d)

What proportion of items in this sample lie within two standard deviations of the mean?

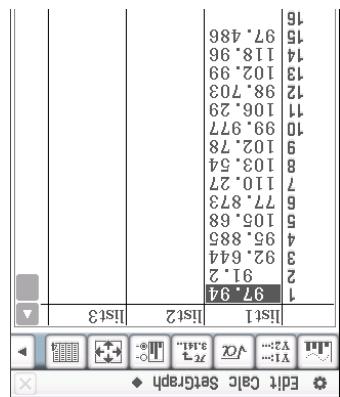
(c)

Calculate the mean and standard deviation for this sample.

(b)

What proportion of items do you expect to lie within two standard deviations of the mean?

(a)



A random sample of 15 items from a normal distribution with a mean of 100 and a standard deviation of 12 are given below.

Question Size: [1, 2, 1 = 6 marks] CA

Mathematics Methods Unit 4

Two digit random numbers have been created using an excel spreadsheet. A screen shot of



1252439 1056974 5916285 6774581 0248229

2050102



114 127 78 108 89 75 121 124

(b) Landline phone numbers in Australia begin with an area code, followed by a 9 and then followed by 7 digits. Starting in column K and row 15, collect a sample of 10 phone numbers (ignoring the area codes).

(a) Scatter in column F and row 5, collect a systematic sample of size 8 of numbers between 74 and 150 inclusive.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
48	84	14	34	52	25	75	15	27	49	15	67	22	46	92	31			
76	33	41	92	64	41	26	41	57	93	23	38	24	65	63	31	34	47	
52	84	38	46	13	46	68	20	98	46	81	47	66	69	48	19			
64	73	60	82	26	46	57	33	18	54	97	67	60	60	49	48			
20	53	89	54	15	65	58	21	64	73	27	75	31	21	24	74			
13	22	76	72	11	41	27	52	44	56	31	54	78	70	10	80			
60	30	22	47	19	79	17	81	55	67	60	66	33	94	78	76			
79	13	45	15	47	18	58	16	48	34	93	25	75	38	72	97	39		
98	59	91	64	33	24	16	48	97	70	77	66	66	85	50	97			
55	74	66	34	93	98	34	97	97	76	58	10	62	28	74	96	64		
89	68	94	10	87	22	17	14	71	18	43	96	50	67	56	45			
64	34	12	73	22	41	11	14	22	64	33	67	50	67	56	45			
12	44	89	12	72	41	11	14	72	41	11	106.29	11	106.29	11	106.29			
80	78	87	93	52	61	89	96	30	83	30	25	25	35	46	34			
45	22	89	87	99	32	94	83	34	50	36	30	76	67	41	33			
61	91	58	64	52	43	20	50	10	21	25	24	39	10	56	97			
45	91	58	64	67	74	58	10	24	82	29	26	24	39	10	56	97		
27	88	51	31	62	85	75	10	92	89	23	66	86	55	43	83			
36	54	47	95	53	88	11	97	92	89	23	66	82	83	56	60			
1252439	1056974	5916285	6774581	0248229														

Mathematics Methods Unit 4

Question Three: [3, 3 = 6 marks] CA



SOLUTIONS
Calculator Assumed
Random Sampling and Distributions

Time: 45 minutes
 Total Marks: 45
 Your Score: / 45

Question One: [2, 2, 3, 3 = 10 marks] CA

For each of the following samples, determine whether the sample is bias and if so, state the reason(s) for the bias.

- (a) During an episode of The Biggest Loser, a weight loss show, the viewing audience were asked to SMS in either Yes or No to the following question: "Do you eat fastfood more than once a week?"

Non response bias

✓ ✓

- (b) A class of Year 8 students are asked to complete a compulsory survey for the following question: "Should the School reduce the lunch hour to 30 minutes?"

Selection bias

✓ ✓

- (c) A random sample of residents in a particular suburb were asked: "Do you prefer Hungry Jacks' over other competitors?"

Design bias and Selection bias

✓ ✓

- (d) Over the course of a Saturday, shoppers in the city central shopping mall were approached and asked: "Do you think the US response to the September 11 attacks was appropriate?"

Selection and Recall/Reporting bias

✓ ✓

Question Two: [5 marks] CA

At the office of Dunder/Mifflin, a company selling stationery supplies, there are the following number of employees:

1 Manager

7 Sales Representatives

2 Office Assistants

3 Accountants

13 Warehouse employees

The Manager, Michael Scott, wants the Human Resources representative to survey 5 staff on the success of their Positivity Day.

If the Human Resources representative does this proportionally, how many of each staff group should he select?

$$\frac{13}{26} \times 5 = 2.5$$

3 warehouse employees

$$\frac{7}{26} \times 5 = 1.35$$

1 sales representative

$$\frac{3}{26} \times 5 = 0.58$$

1 accountant