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# Teaching Statistics in the new A level using graphing technology

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# Overarching themes and use of technology

Paragraph 8 of the Content Document states that –  
8. The use of technology, in particular mathematical and statistical graphing tools and spreadsheets, must permeate the study of AS and A level mathematics.

Calculators used must include the following features:

- An iterative function
- The ability to compute summary statistics and access probabilities from standard statistical distributions

# CALCULATOR HINTS FOR STATISTICS

## - STAT MENU (2) on Casio CG10/20

It is advised that mean and standard deviation are obtained directly from a calculator.

### 1. Numerical measures

(a) Mean and standard deviation, without frequencies

List 1: input x 1 2 3 4 5

Rad Norm1 d/c Real

	List 1	List 2	List 3	List 4
SUB				
1	1			
2	2			
3	3			
4	4			

GRAPH CALC TEST INTR DIST

F2 (CALC)

Rad Norm1 d/c Real

	List 1	List 2	List 3	List 4
SUB				
1	1			
2	2			
3	3			
4	4			

1-VAR 2-VAR REG SET

F6 SET

	List 1	List 2	List 3	List 4
SUB				
1	1			
2	2			
3	3			
4	4			

1-VAR 2-VAR REG SET

1 Var X List: List 1  
F1 1 Var Freq : 1

	XList	YList	Freq
1Var	List1		
1Var			1
2Var	List1		
2Var	List2		
2Var			1

1 LIST

EXIT

F1 (1 VAR)

1-Variable	
$\bar{x}$	=3
$\Sigma x$	=15
$\Sigma x^2$	=55
$\sigma x$	=1.41421356
$sx$	=1.58113883
n	=5

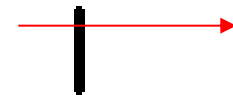
1-Variable	
minX	=1
Q1	=1.5
Med	=3
Q3	=4.5
maxX	=5
Mod	=1

List 1: input x 1 2 3 4 5

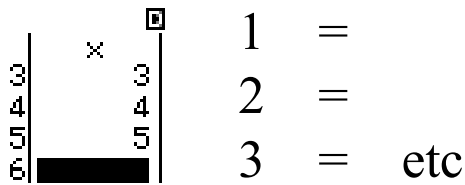


Press  
6

- 1:1-Variable
- 2: $y=a+bx$
- 3: $y=a+bx+cx^2$
- 4: $y=a+b \cdot \ln(x)$



Press  
1



OPTN

- 1:Select Type
- 2:Editor
- 3:1-Variable Calc
- 4:Statistics Calc



Press  
3

```

x̄ = 3
Σx = 15
Σx² = 55
σ²x = 2
σx = 1.414213562
s²x = 2.5
    
```

## Frequencies given

List 1: input  $x$                     1   2   3   4   5

List 2: input frequencies        2   5   8   4   2

For grouped data, the mid values should be entered into List 1. This can be done by entering, for example,  $(34.5 + 39.5)/2$  directly into List 1.

F2 (CALC)

F6 SET

1 Var X List : List 1

1 Var Freq : List 2

	List 1	List 2	List 3	List 4
SUB				
1	1	2		
2	2	5		
3	3	8		
4	4	4		

1Var XList	: List 1
<b>1Var Freq</b>	<b>: List 2</b>
2Var XList	: List 1
2Var YList	: List 2
2Var Freq	: 1

EXIT

F1 (1 VAR)

1-Variable	
$\bar{x}$	= 2.95238095
$\Sigma x$	= 62
$\Sigma x^2$	= 208
$\sigma x$	= 1.09004982
$sx$	= 1.11696868
$n$	= 21

## FREQUENCY TABLES

If the data comes from a frequency table, ClassWiz can be set up to input the data values in one column, and the frequencies in another.

```
1:Input/Output
2:Angle Unit
3:Number Format
4:Engineer Symbol
```

```
1:Fraction Result
2:Complex
3:Statistics
4:Spreadsheet
```

```
Frequency?
1:On
2:Off
```

To access the set-up menu, press **SHIFT** **MENU**  
(SET UP).

Press the down arrow (**▼**) to reach the second  
page and **3** to select the Statistics settings.

Press **1** to turn the Frequency option On.



List 1: input  $x$

1 2 3 4 5

List 2: input frequencies

2 5 8 4 2

$x$	Freq
1	2
2	5
3	8
4	4
5	2

OPTN

1:Select Type  
2:Editor  
3:1-Variable Calc  
4:Statistics Calc

Press  
3

$\bar{x}$  = 3.08  
 $\bar{y}$  = 77  
 $\bar{Mx^2}$  = 291  
 $\sigma^2x$  = 2.1536  
 $\sigma x$  = 1.467514906  
 $\sigma^2x$  = 2.243333333



## (b) Mean and standard deviation with frequencies

A six-sided die was thrown a large number of times and the scores recorded as follows.

Score, $x$	Frequency, $f$
1	31
2	17
3	21
4	24
5	17
6	25

1. Find the mode.
2. Find the mean.
3. What is the median score?

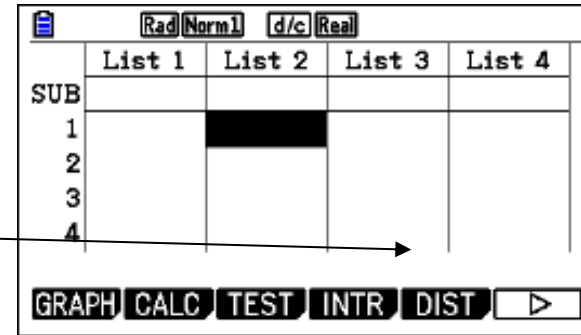
Calculators must be used to find probabilities.

## 2. Binomial Distribution

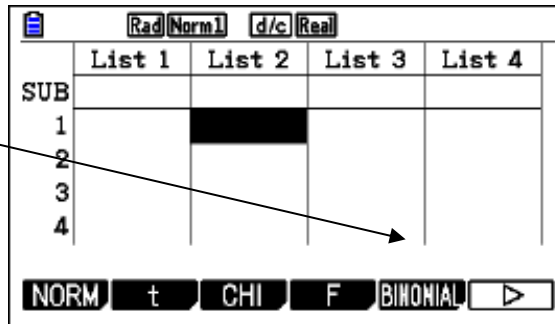
(a) Probabilities of type  $P(X = x)$ :

eg  $X \sim B(15, 0.2)$        $P(X = 3)$

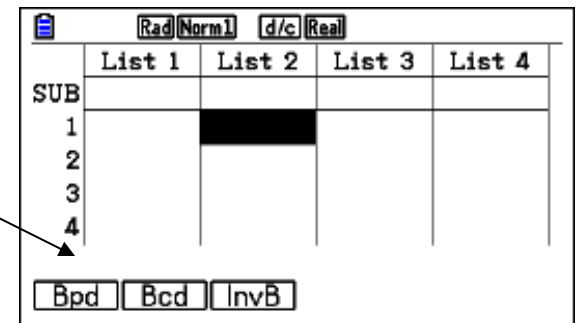
F5 DIST



F5 BINOMIAL



F1 Bpd

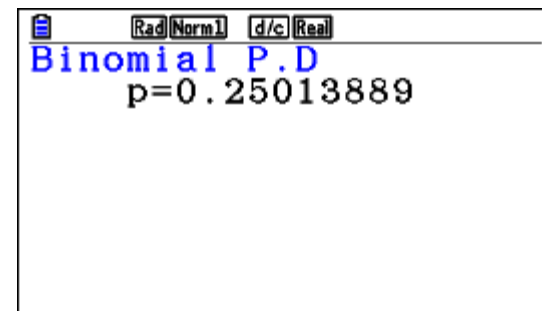
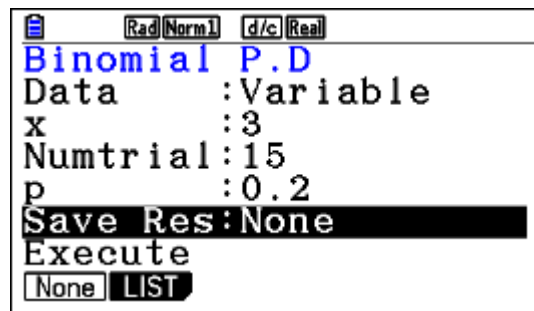


Data Variable

x 3      EXE

Numtrial 15 EXE

p 0.2      EXE



eg  $X \sim B(15, 0.2)$

$P(X = 3)$



Press  
7

- 1:Normal PD
- 2:Normal CD
- 3:Inverse Normal
- 4:Binomial PD

Press 4  
Binomial  
PD

- 1:List
- 2:Variable

Press 2  
Variable

Binomial PD  
X : 3  
N : 15  
p : 0.2

3 Press =  
15 Press =  
0.2 Press =  
Press =

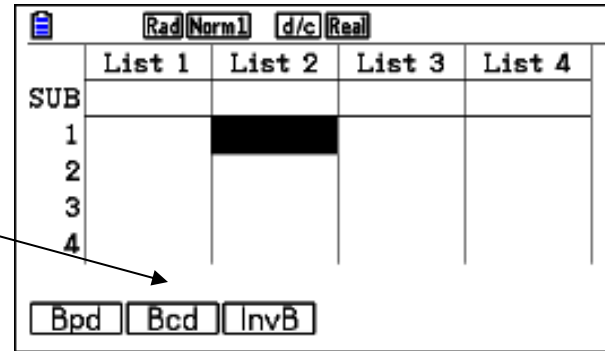
P=

0.2501388953

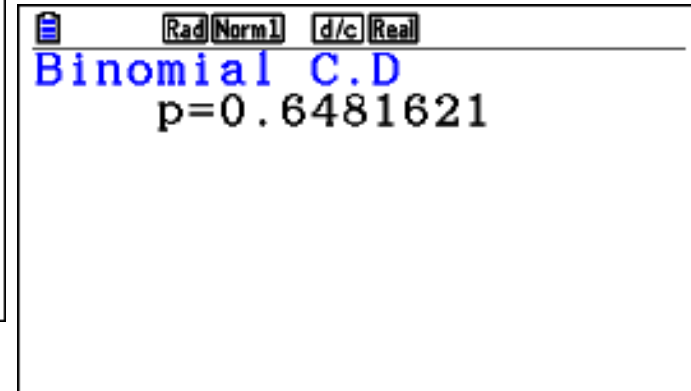
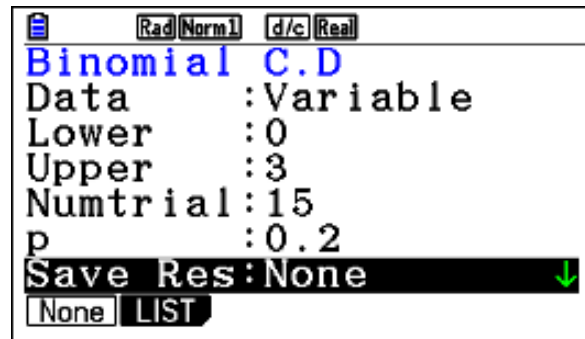
(b) Probabilities of type  $P(X \leq x)$ :

eg  $X \sim B(15, 0.2)$   $P(X \leq 3)$

F2 Bcd




Upper 3 EXE  
 Numtrial 15 EXE  
 p 0.2 EXE  
 Execute F1 (calc)



(b) Probabilities of type  $P(X \leq x)$ :  
eg  $B(15, 0.2)$   $P(X \leq 3)$

Use down arrow to navigate to more opts  
Press 1  
BinomialCD



7:Distribution

Press 7

1:Binomial CD  
2:Poisson PD  
3:Poisson CD

|

1:List  
2:Variable

Press 2  
Variable

Binomial CD  
X :3  
N :15  
p :0.2

3 Press =  
15 Press =  
0.2 Press =  
Press =

P=

0.6481621047

A hotel has 50 single rooms, 16 of which are on the ground floor. The hotel offers guests a choice of a full English breakfast, a continental breakfast or no breakfast. The probabilities of these choices being made are 0.45, 0.25 and 0.30 respectively. It may be assumed that the choice of breakfast is independent from guest to guest.

- (a) On a particular morning there are 16 guests, each occupying a single room on the ground floor. Calculate the probability that exactly 5 of these guests require a full English breakfast.
- (b) On a particular morning when there are 50 guests, each occupying a single room, determine the probability that:
- (i) at most 12 of these guests require a continental breakfast;
  - (ii) More than 10 but fewer than 20 of these guests require no breakfast.

- (a) On a particular morning there are 16 guests, each occupying a single room on the ground floor. Calculate the probability that exactly 5 of these guests require a full English breakfast. (3 marks)

```

Rad Norm1 d/c Real
Binomial P.D
Data : Variable
x : 5
Numtrial: 16
p : 0.45
Save Res: None
Execute
    
```

```

Rad Norm1 d/c Real
Binomial P.D
p=0.11228837
    
```

- (b) On a particular morning when there are 50 guests, each occupying a single room, determine the probability that:

- (i) at most 12 of these guests require a continental breakfast; (2 marks)

```

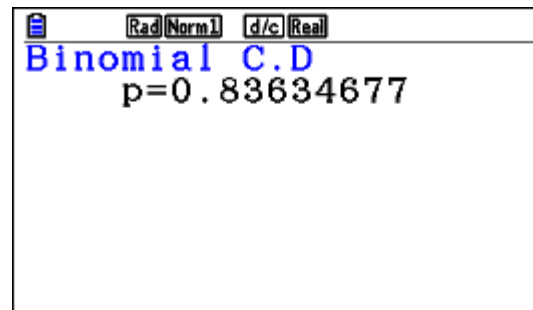
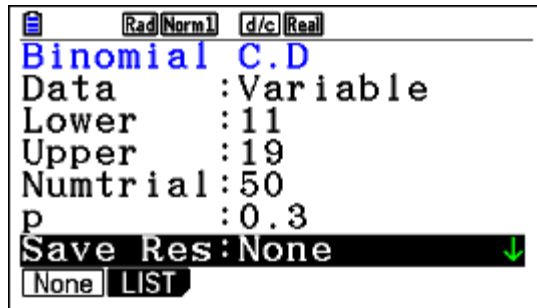
Rad Norm1 d/c Real
Binomial C.D
Data : Variable
Lower : 0
Upper : 12
Numtrial: 50
p : 0.25
Save Res: None
None LIST
    
```

```

Rad Norm1 d/c Real
Binomial C.D
p=0.51098617
    
```



- (ii) more than 10 but fewer than 20 of these guests require no breakfast. (3 marks)



It is advised that students should be aware of the method involved as questions may involve being asked to **show** a result.

### 3. Discrete Probability Distributions: Expectation and variance

List 1: input  $x$                                 0    1    2    3  
 List 2: input probabilities                0.1 0.3 0.4 0.2

CALC F2

SET

EXIT

1Var	XList	:List1
1Var	Freq	:List2
2Var	XList	:List1
2Var	YList	:List2
2Var	Freq	:1

LIST

	List 1	List 2	List 3	List 4
SUB				
1	0	0.1		
2	1	0.3		
3	2	0.4		
4	3	0.2		

GRAPH CALC TEST INTR DIST

1 VAR

	List 1	List 2	List 3	List 4
SUB				
1	0	0.1		
2	1	0.3		
3	2	0.4		
4	3	0.2		

1-VAR 2-VAR REG SET

1-Variable	
$\bar{x}$	=1.7
$\sum x$	=1.7
$\sum x^2$	=3.7
$\sigma x$	=0.9
$sx$	=
$n$	=1

↓

$$\bar{X} = E(X) \sum x = E(X) \sum x^2 = E(X^2) \quad \sigma \text{ given}$$

Check  $n = 1$

List 1: input  $x$

0    1    2    3

List 2: input probabilities

0.1    0.3    0.4    0.2



Press  
=

1:1-Variable  
2: $y=a+bx$   
3: $y=a+bx+cx^2$   
4: $y=a+b \cdot \ln(x)$

Press 1 1-Variable

	x	Freq
1		

Enter  
data

	x	Freq
1	0	0.1
2	1	0.3
3	2	0.4
4	3	0.2

1:Select Type  
2:Editor  
3:1-Variable Calc  
4:Statistics Calc

Press OPTN  
Press 3  
1-Variable

$\Sigma x$  = 1.7  
 $\Sigma x^2$  = 3.7  
 $\sigma^2 x$  = 0.81  
 $\sigma x$  = 0.9  
 $S^2 x$  =

$\Sigma x$  =  
n = 1  
min(x) = 0  
Q1 = 1  
Med = 2  
Q3 = 2

## Example

For the following probability distribution,

$x$	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
$P(X=x)$	0.08	0.30	0.34	0.15	0.10	0.03

- calculate
- (a)  $E(X)$
  - (b)  $E(X^2)$
  - (c) the variance of  $X$
  - (d) the standard deviation of  $X$

	List 1	List 2	List 3	List 4
SUB				
1	0	0.08		
2	1	0.3		
3	2	0.34		
4	3	0.15		

1-VAR 2-VAR REG SET

	Rad	Norm1	d/c	Real
<b>1-Variable</b>				
$\bar{X}$	=	1.98		
$\Sigma X$	=	1.98		
$\Sigma X^2$	=	5.36		
$\sigma X$	=	1.19983332		
SX	=			
n	=	1		

- (a)  $E(X) = 1.98$
- (b)  $E(X^2) = 5.36$
- (c)  $\text{Var} = 5.36 - 1.98^2 = 1.44$
- (d)  $\text{sd} = 1.20$

It is advised that z values and methods are shown and the calculator is used for checking results.

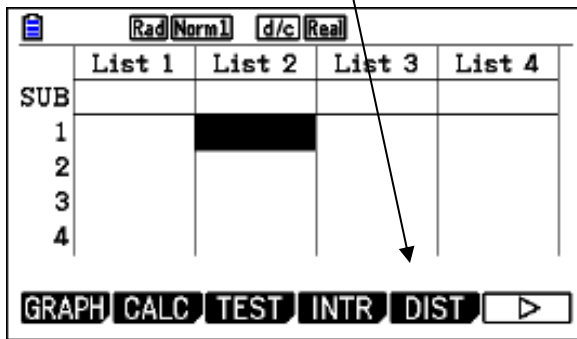
### 4. Normal Distribution: Calculation of probabilities

(a) Probabilities of types  $P(X \leq x)$ ,  $P(X < x)$ ,  $P(X > x)$  and  $P(X \geq x)$  can be found directly

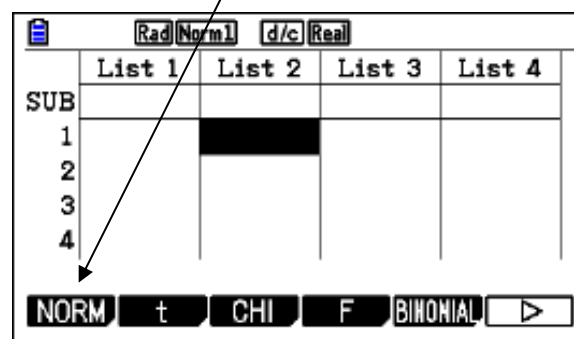
eg  $X \sim N(135, 15^2)$

$P(X \leq 127)$  or  $P(X < 127)$

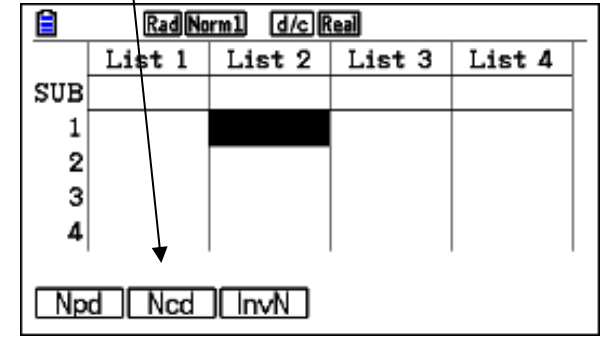
F5 DIST



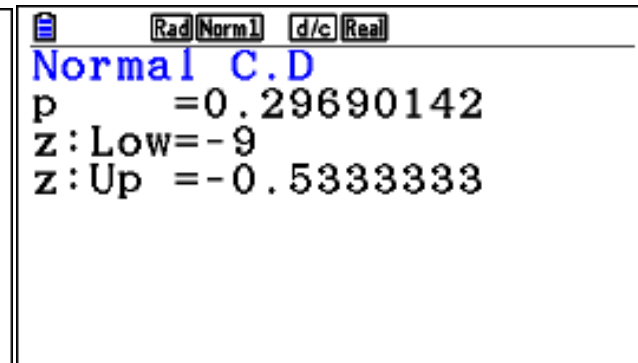
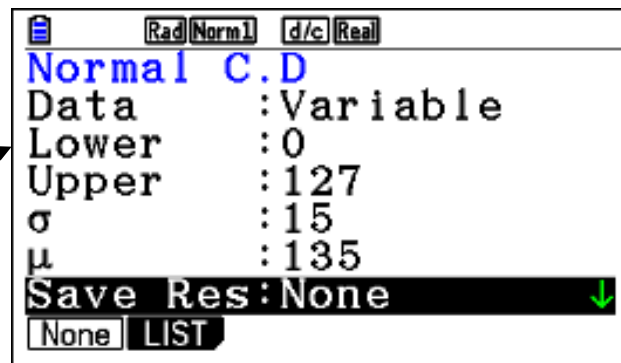
F1 Norm



F2 Ncd



Select a suitable Lower value



eg  $X \sim N(135, 15^2)$

$P(X \leq 127)$  or  $P(X < 127)$



Press  
7

- 1:Normal PD
- 2:Normal CD
- 3:Inverse Normal
- 4:Binomial PD



Press 2

Normal CD  
Lower: 0  
Upper: 127  
 $\sigma$  : 15

Normal CD  
Upper: 127  
 $\sigma$  : 15  
 **$\mu$  : 135**

Enter  
data  
then =

P=

0.2969014278

eg  $X \sim N(135, 15^2)$

$P(X \geq 118)$  or  $P(X > 118)$

Select a suitable Upper value

```

Normal C.D
Data      :Variable
Lower     :118
Upper     :200
σ         :15
μ         :135
Save Res :None
None LIST
    
```

```

Normal C.D
p         =0.8714555
z:Low    =-1.1333333
z:Up     =4.3333333
    
```

eg  $X \sim N(135, 15^2)$

$P(119 < X < 128)$

```

Normal C.D
Data      :Variable
Lower     :119
Upper     :128
σ         :15
μ         :135
Save Res :None
None LIST
    
```

```

Normal C.D
p         =0.17730799
z:Low    =-1.0666667
z:Up     =-0.4666666
    
```



eg  $X \sim N(135, 15^2)$

$P(X \geq 118)$  or  $P(X > 118)$



Press  
7

- 1:Normal PD
- 2:Normal CD
- 3:Inverse Normal
- 4:Binomial PD

← Press 2

Normal CD	Normal CD
Lower:118	Upper:200
Upper:200	$\sigma$ :15
$\sigma$ :15	$\mu$ :135

Enter  
data  
then =

P= 0.8714555072

eg  $X \sim N(135, 15^2)$   $P(119 < X < 128)$

Normal CD	Normal CD
Lower:119	Upper:128
Upper:128	$\sigma$ :15
$\sigma$ :15	$\mu$ :135

P= 0.1773079985

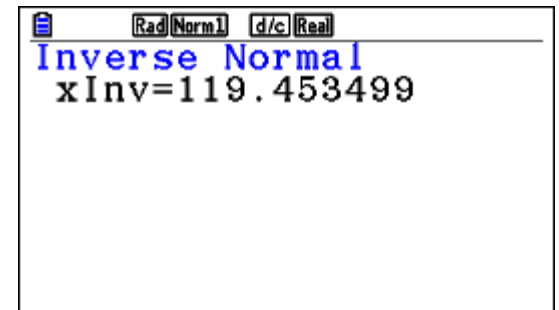
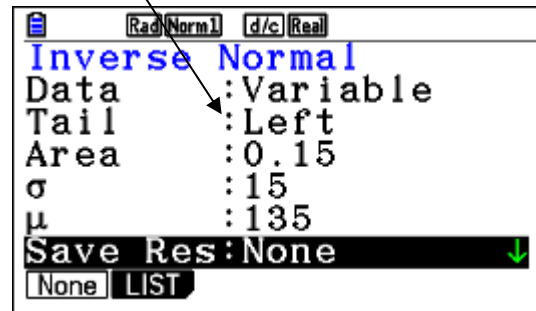
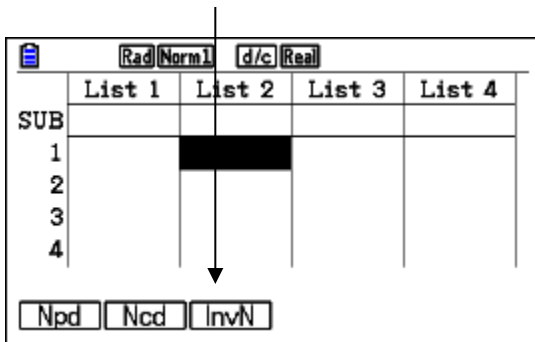
(b) Problems involving inverse normal probabilities:

eg  $X \sim N(135, 15^2)$  Find value of  $x$  such that  $P(X < x) = 0.15$

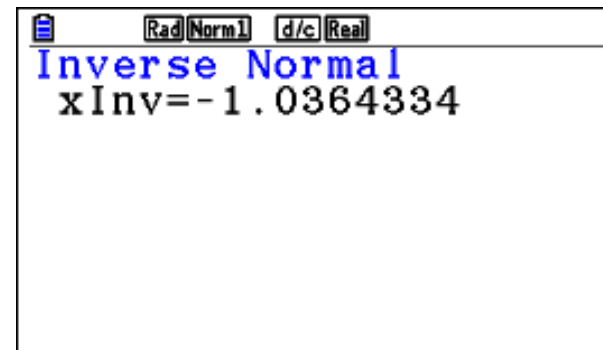
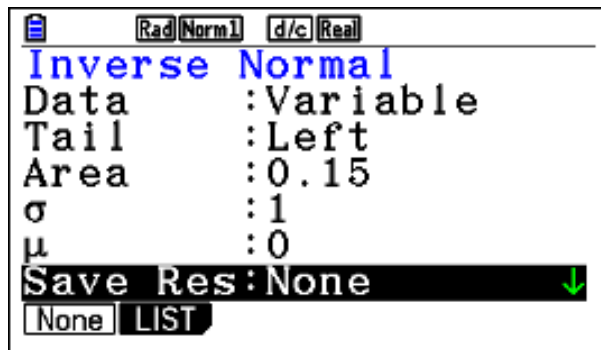
F5 DIST F1 NORM

F3 InvN

Area Left

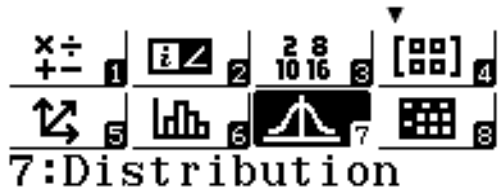


z scores corresponding to area can also be obtained (InvNormal tables)



eg  $X \sim N(135, 15^2)$

Find value of  $x$  such that  $P(X < x) = 0.15$



Press  
7

1: Normal PD  
2: Normal CD  
3: Inverse Normal ← Press 3  
4: Binomial PD

Inverse Normal  
Area : 0.15  
 $\sigma$  : 15  
 $\mu$  : 135

Enter  
data  
then =

xInv=

119.4535129

Note: area is always  
to the left

eg  $X \sim N(135, 15^2)$

Find value of  $x$  such that  $P(X > x) = 0.30$

Area right this time

```

Rad Norm1 d/c Real
Inverse Normal
Data : Variable
Tail : Right
Area : 0.3
σ : 15
μ : 135
Save Res: None
None LIST
    
```

```

Rad Norm1 d/c Real
Inverse Normal
xInv=142.866008
    
```

```

Inverse Normal
Area : 0.70
σ : 15
μ : 135
    
```

```

xInv=
142.8660066
    
```

Area to left is 0.70

# About MEI

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- We offer continuing professional development courses, provide specialist tuition for students and work with industry to enhance mathematical skills in the workplace
- We also pioneer the development of innovative teaching and learning resources