

Activity 8

Normal Distribution

Topic Area: Data Analysis and Probability

NCTM Standard: Select and use appropriate statistical methods to analyze data.

Objective: The student will be able to utilize the Casio fx-9860G Plus calculator to determine the range of values, limit of intervals, and probability of values on a normal distribution.

Introduction: This activity is designed to demonstrate the procedure to enter data into the Casio fx-9860G Plus graphing calculator in order to determine the range of values, limits of intervals, and probability of values on a normal distribution that students will need to evaluate from a given set of data.

The students should be familiar with the following vocabulary.

Interval range

Normal Curve

Normal Distribution

Probability

Range limits

Students should also be familiar with the normal distribution graph. They should understand where the mean is located on the graph and 1, 2 and 3 standard deviations from the mean. They should also understand that the graph contains 100% of the data with 50% of the data above the mean and 50% of the data below the mean. One standard deviation contains 68.3% of the data centered about the mean. Two standard deviations contain 95.5% of the data centered about the mean. Three standard deviations contain 99.7% of the data centered about the mean. Students should also have access to t-P tables.

Calculator Notes for Activity 8

Objective: The student will be able to utilize the Casio fx-9860G Plus calculator to determine the range of values, limit of intervals, and probability of values on a normal distribution.

Steps for Using Normal Distribution

Problem: A test was administered to 20,000 students and the results were normally distributed. The mean score on the test was 64. The standard deviation was 8. Determine the following:

1. How many students are one deviation from the mean? Two? Three? 1.6 deviations?
2. What scores are one deviation from the mean? Two? Three? 1.6 deviations?
3. How many students will score between 50 and 70 on the test?
4. How many students will score above 72?
5. How many students will score above 50?
6. Find the upper and lower limits of an interval about the mean within which 80% of the students scored.
7. Find the limit below which 90% of the students lie.
8. If the passing score was 50, how many of the students passed?

Using the fx-9860G Plus calculator makes these questions very easy to calculate.

1. How many students are one deviation from the mean? Two? Three? 1.6 deviations? To answer this question you need to use the following probability numbers from the t-P tables:

- 1 deviation = .683
- 2 deviations = .955
- 3 deviations = .997
- 1.6 deviations = .891

- 1 deviation = $(.683)(20000) = 13,660$
- 2 deviations = $(.955)(20000) = 19,100$
- 3 deviations = $(.997)(20000) = 19,940$
- 1.6 deviations = $(.891)(20000) = 17,820$

2. What scores are the range limits for one deviation from the mean? Two? Three? 1.6? To answer this question, use the fx-9760G Plus graphing calculator. Turn the calculator on, go to the STAT menu, to DIST, to NORM and then to Inverse Normal. Use the following key strokes to get to the screen that follows.

O\$lyqe

```

Inverse Normal
Tail :Left
Area :0
σ :1
μ :0
Save Res:None
Execute
|LEFT|RIGHT|CNTR

```

On this screen, set the Tail to Central, Area to .683, S (standard deviation) to 8, m (mean) to 64, Save Res should be left at None, and Execute go to Calc. Use these keystrokes to get to the following screen.

eN.683NI8I64INq

```

Inverse Normal
x:Low=55.9948654
x:UP =72.0051346

```

The scores at 1 deviation range from 56 to 72.

Repeat the same key strokes for 2 deviations (using .955 for Area), 3 deviations (using .977 for Area) and 1.6 deviations (using .891 for Area). The following screens will yield your answers.

```
Inverse Normal  
x:Low=47.9627643  
x:UP =80.0372357
```

The scores at 2 deviation range from 48 to 80.

```
Inverse Normal  
x:Low=40.2580966  
x:UP =87.7419034
```

The scores at 3 deviation range from 40 to 88.

```
Inverse Normal  
x:Low=51.1783673  
x:UP =76.8216327
```

The scores at 1.6 deviation range from 51 to 77.

3. How many students will score between 50 and 70 on the test? To answer this question, exit this screen, go

to DIST, NORM and Normal C.D. Use these key strokes to get to the following screen.

ddyqw

```
Normal C.D
Lower :0
Upper :0
σ :8
μ :64
Save Res:None
Execute
```

On this screen, set the lower limit to 50 and the upper limit to 70. Leave the standard deviation 8, and the mean 64. Use these key strokes to get the following screen.

50|70||

```
Normal C.D
P =0.73331349
z:Low=-1.75
z:UP =0.75
```

This means that the probability is .733. Therefore, multiply the probability by the total number of students to get the answer.

```
20000*.733
14660
FMT
```

There will be 14,660 students that score between 50 and 70 on the test,

4. How many students will score above 72? To answer this question, recall that 50% of the students will score above the mean of 64 and 50% of the students will score below the mean of 64.

$$50\% \text{ of the } 20,000 \text{ students} = 10,000$$

Therefore, you need to find the number of students between 64 and 72.

Use these keystrokes to get to the following screen.

p\$lyqw64|72||

```
Normal C.D
P      =0.34134474
z:Low=0
z:UP  =1
```

$$(20000)(.341) = 6,820 \text{ students.}$$

To find the students above 72, subtract 6820 from 10000.

$$10000 - 6820 = 3180$$

Therefore, 3,180 students scored above 72.

5. How many students will score above 50?

To find this answer, you will need to find the number of students that score between 50 and 64 (the mean). Then add these students to 10,000 (the other 50%).

Use these key strokes to get to the following screen.

p\$lyqw50l64ll

```
Normal C.D
P      =0.45994084
z:Low=-1.75
z:UP  =0
```

Since the probability = .460, use the following steps.

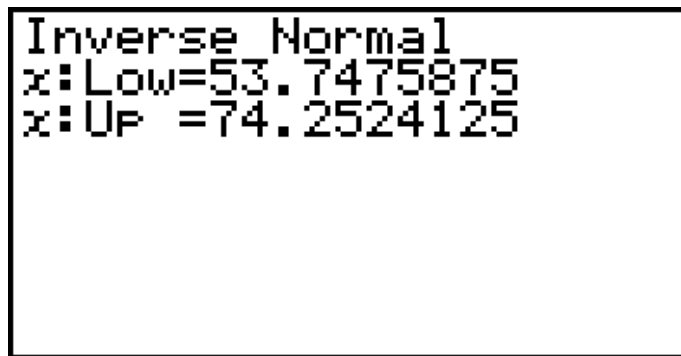
$$(20000)(.460) = 9200$$
$$10000 + 9200 = 19,200$$

Therefore, 19,200 students will score above 50 on the test.

6. Find the upper and lower limits of an interval about the mean within which 80% of the students scored.

To solve this problem, use the Inverse Normal screen to enter the probability of 80% (.800) into the Area. Use these key strokes to get to the following screen.

p\$lyqeN.8ll



```
Inverse Normal
x:Low=53.7475875
x:UP =74.2524125
```

This means that 80% of the students scored between 54 and 74 on the test.

7. Find the limit below which 90% of the students lie.

To answer this question, you need to recall that the limits need to center about the mean. This problem has 50% below the mean and 40% above the mean. The limit we need is the upper limit of the 40% section. If 40% is above the mean then 40% would be below the mean and

80% would be centered about the mean. Use the Inverse Normal screen to determine the limits. Use these key strokes to get the following screen.

pyqeN.8ll

```
Inverse Normal  
x:Low=53.7475875  
x:UP =74.2524125
```

Therefore, 90% of the students scored below 74.

8. If the passing score was 50, how many of the students passed?

To solve this problem, you need to find the number of students between 50 and 64, then add these students to 10,000 (50% of the students). Therefore, use the Normal C.D. screen to fill in the limits to find the probability. Use these keystrokes to get the following screen.

pldyqw50l64ll

```
Normal C.D  
P =0.45994084  
z:Low=-1.75  
z:UP =0
```

Since the probability is .460, use the following calculations.

$$(20000)(.460) = 9200$$

$$10000 + 9200 = 19,200 \text{ students}$$

Therefore, 19,200 students passed the test.

Name _____ Class _____ Date _____

Activity 8: Worksheet

Normal Distribution

Problem: A test was administered to 1,500 students and the results were normally distributed. The mean score on the test was 56. The standard deviation was 6.2. Determine the following:

1. How many students are .7 deviations from the mean? (from the t-P table, .7 deviations = .516).
2. What scores are .7 deviations from the mean?
3. How many students will score between 60 and 65 on the test?

4. How many students will score above 65?
5. How many students will score below 63?
6. Find the upper and lower limits of an interval about the mean within which 75% of the students scored?
7. Find the score that students had to get to be in the upper 10%.
8. If the passing score was 50, how many of the students passed?

Solutions to Activity 8: Worksheet

1. 774
2. 52 to 60
3. 279
4. 645
5. 1,305
6. 49 to 63
7. 64
8. 1,245