

Using a Normal Distribution

The following problem will be used to practice using a normal distribution in the calculator:

In the 2018-2019 season, the height of NBA players had a mean of 6 ft. 7 in. and a standard deviation of 5 in. Assume the data is normally distributed.

Problems:

a.) What is the probability that a randomly selected NBA player has a height that is shorter than 6 ft. 3 in.?

b.) What is the probability that a randomly selected NBA player has a height that is taller than 7 ft.?

c.) What is the probability that a randomly selected NBA player has a height between 6 ft. 5 in. and 6 ft. 10 in.?

d.) What is the tallest height that would still place an NBA player in the bottom 10% of players' heights?

e.) What is the shortest height that would still place an NBA player in the top 25% of players' heights?

The questions being asked indicate to assume that this is a normal distribution. A normal distribution is a continuous probability distribution for a random variable, x , where the mean, median, and mode are all equal. The normal curve is bell-shaped and symmetric about the mean, and the total area under the curve is equal to 1. The normal probability distribution strictly depends on the mean and the standard deviation. A z -score can be used to solve for the probabilities using a graph or a table, but technology can also be used to solve for the probabilities. The TI calculator does the hard work for you by calculating the z -score and using that to find the probability. We will use the calculator to answer the questions on the previous page, by using the *normalcdf* function. This function is used as follows:

$$\text{normalcdf}(\text{lower value}, \text{upper value}, \text{mean}, \text{standard deviation})$$

a.) $P(x < 6 \text{ ft. } 3 \text{ in.})$

Let's think about this for a second... The height values are given in feet and inches, so we need to convert to have all the values in inches. Remember, there are 12 in. in 1 foot.

You first convert the feet, and then add the inches $\rightarrow \frac{6\text{ft}}{1} \times \frac{12\text{in}}{1\text{ft}} = 72\text{in} + 3\text{in} = 75\text{in}$

6 ft. 3 in. = 75 in. This gives us that $P(x < 6 \text{ ft. } 3 \text{ in.}) = P(x < 75 \text{ in.})$.

We are told in the problem that the mean is equal to 6 ft. 7 in. So, $\mu = 79$ and the standard deviation is equal to 5 in., $\sigma = 5$.

To compute the probability follow the sequence:

2nd > DISTR > scroll down to 2: normalcdf > ENTER > -1E99, 75, 79, 5)

(Screen 1)

ENTER

(Screen 2)

The probability of randomly selecting an NBA player who is shorter than 6 ft. 3 in. is 0.212 (or about 21%).

***Note:** we use -1E99 to create the left tail and 1E99 to create the right tail (our lower and upper limits) on our normal distribution graph. You get this 1E99 by doing:

1 > 2nd > EE > 99

(Screen 3)

Screen 1

```
normalcdf(-1E99
```

Screen 2

```
normalcdf(-1E99
.2118553337
```

Screen 3

```
1E99
```

b.) $P(x > 7 \text{ ft.}) = P(x > 84 \text{ in})$

Screen 4

Again, we will use $\mu = 79$ and $\sigma = 5$.

Input this sequence in the calculator:

2nd > **DISTR**(on top of VARS) > Scroll down to **2: normalcdf** > **ENTER** >
84, 1E99, 79, 5)

(Screen 4)

ENTER

(Screen 5)

The probability of randomly selected an NBA player taller than 7ft is 0.159 (or about 16%).

***Note:** Again, we are using the 1E99 to make the right tail (our upper limit, in this case) for the normal distribution graph.

```
normalcdf(84,1E99,79,5)
```

Screen 5

```
normalcdf(84,1E99,79,5)
.1586552596
```

c.) $P(6 \text{ ft. } 5 \text{ in} < x < 6 \text{ ft. } 10 \text{ in}) = P(77 \text{ in} < x < 82 \text{ in})$

Screen 6

Once more, we use the mean, $\mu = 79$, and standard deviation, $\sigma = 5$.

Now, we want the probability of a randomly selected NBA player to be between 77 in. and 82 in. tall.

Follow this sequence:

2nd > **DISTR** > Scroll down to **2: normalcdf** > **ENTER** > **77, 82, 79, 5)**

(Screen 6)

ENTER

(Screen 7)

This gives us a probability of 0.381 (or about 38%) of randomly selecting an NBA player that is between 6ft. 5in. and 6ft. 10in. tall.

```
normalcdf(77,82,79,5)
```

Screen 7

```
normalcdf(77,82,79,5)
.3811686325
```

d.) $P(x < k) = 0.10$

For this problem, we want the tallest height that would still place an NBA player in the **bottom** 10% of the players' heights. We are looking at the left hand tail of the graph and again, we use the mean, $\mu = 79$, and the standard deviation, $\sigma = 5$.

Follow the sequence:

2nd > DISTR > scroll down to 3: invNorm(> ENTER > 0.10, 79, 5)

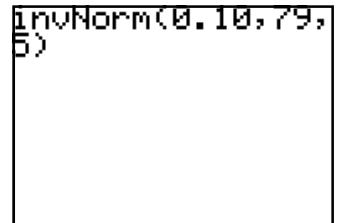
(Screen 8)

ENTER

(Screen 9)

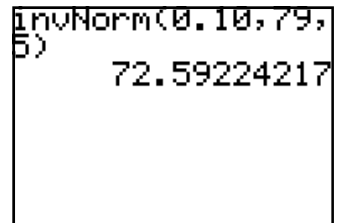
The tallest height that would still place an NBA player in the bottom 10% of players' heights is 72.59 in., which is about 6 ft. 1 in.

Screen 8



```
invNorm(0.10, 79, 5)
```

Screen 9



```
invNorm(0.10, 79, 5)
72.59224217
```

e.) $P(x > k) = 0.25$

Here, we want the shortest height that will still put an NBA player in the **top** 25% of player heights. This time, we are looking at the right tail of the graph, and remember that the area under the graph is all equal to 1. So, what we have to do is subtract the 25% from 1 to get our shortest height ($1 - 0.25 = 0.75$).

We are still using $\mu = 79$ and $\sigma = 5$.

Input this sequence in the calculator:

2nd > DISTR > scroll down to 3: invNorm(> ENTER > 0.75, 79, 5)

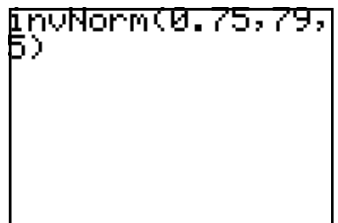
(Screen 10)

ENTER

(Screen 11)

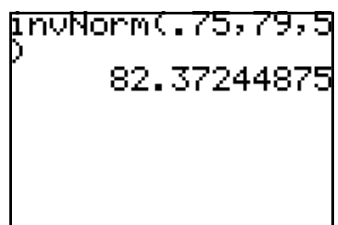
We get an answer of 82.37 in. This means that the shortest height that would still place an NBA player in the top 25% of players' height is 82.37 in, or about 6 ft. 10 in.

Screen 10



```
invNorm(0.75, 79, 5)
```

Screen 11



```
invNorm(0.75, 79, 5)
82.37244875
```