A distribution is normal when the majority of data points are alike, so they fall under a small range of values with some outliers on both the high and low end. It is what is talked about when a bell-shaped curve is mentioned or when a continuous probability distribution is mentioned. The curve has to be symmetrical over the mean vertically and approach the horizontal axis but never touch it. To say that the adult male heights are normally distributed means that half the values are above the mean and half the values are below the mean which should make the value under the normal curve be one. A z-table can be very useful with normal distributions.

The z-table for a standard normal distribution is a left-tail style table that gives cumulative areas to the left of a specific z. It is used to find areas and probabilities associated with the standard normal distribution. It can be used when trying to find the area to the left of a specific z-value by just looking at the correct rows and columns in the table to get the area to the left of that z-value. For areas to the right of the z-value being looked for, you would have to find the area to the left of that z-value first and then subtract that area from one. For two z-values, the area is found by subtracting the first z-value area to the left from the second z-value area to the left. A strength of the table is that it is standard, so it works for any normal distribution when the values of that normal distribution are converted to their z-values. A weakness is that it can only be used for normal distributions. Also, there aren’t any approximations being used in the table, it is just the exact value of the z to get the exact area.

For the normal x-distribution of adult male heights, we expect for 68% of the area under the curve to be between 67 and 73 by use of the Empirical Rule. Also, we expect for 95% of the area under the curve to be between 64 and 76. Lastly, we expect for 99.7% of the area under the curve to be between 61 and 79.

For the normal x-distribution of adult female heights, we expect for 68% of the area under the curve to be between 61 and 67 by use of the Empirical Rule. Also, we expect for 95% of the area under the curve to be between 58 and 70. Lastly, we expect 99.7% of the area under the curve to be between 55 and 73.

To get P (64<x<76) using the Empirical Rule, all we would have to do is look back to see our percentages where it specifies the Empirical Rule for adult male heights two paragraphs before this. This shows us that the area under the curve is between 64 and 76 for 95% of the data, so the probability is 0.95. For the z-table, we first need to convert the x’s of 64 and 76 to z’s by using the z-score formula of z equals x minus the mean divided by the standard deviation. With this formula, then it would be asking for P ( -2 ≤ z ≤ 2). Then, you would look for z ≤ -2 in the z-table by going down the column of z’s on the table until you find -2 and then you look at the rows and pick the one it relates to, which in this case is .00, which makes that z =.0228. You would find z ≤ 2 in the same way and that makes z = .9772. It would then just be a matter of subtracting the smaller z from the larger z, meaning .9772-.0228 for the probability to be .9544. For the graphing calculator, you use 2nd, then click on vars, and then click on 2 to use normalcdf. All you have to do is fill in the normalcdf screen with the lower number, upper number, mean, and standard deviation that are part of the problem; so for this it would be 64 in lower, 76 in upper, 70 as the mean, and 3 as the standard deviation. The answer for it is then .954499876 which is the same as the first two, just more in detail, so the probability is .95 in some way whatever method you use.

To get P (58<x<70) using the Empirical Rule, all we would need to do is look back to see our percentages where it specifies the Empirical Rule for adult female heights a few paragraphs before. This shows that the area under the curve is between 58 and 70 for 95% of the data, so the probability is 0.95. For the z-table we have to convert 58 and 70 to z’s in the same way as we did in the paragraph before this. This would make z ≤ -2 and z ≤ 2, and we find these z’s in the same way as before, so they would be z =.0228 and z =.9772, and then you just subtract the smaller from the larger or .9772-.0228 which would make the probability be .9544. For the graphing calculator, you use the same steps as before but just with the lower being 58, the upper being 70, the mean being 64, and the standard deviation being 3. The answer for it is then .954499876 like the adult male heights got, so it is also just more detailed in this method, and the answer is 0.95 as the probability like the first two methods.

I noticed that the answers in these two paragraphs right before this were exactly the same even though they were for different normal distributions. This is because even with the different values for x, mean, and standard deviation, the z-scores both came out to be -2 and 2 for the adult male and female heights, so the actual z’s for both heights ended up being the same, which made the probability end up the same for both heights.

The Empirical Rule can be used for P (61< x < 73) because when you look at the graph and shade in between these two points there is still a clear number you can get. When looking at the graph you see that 70 is the mean with 61 being 3 standard deviations away which gives us 50% with just the shading of that because it is half of the curve. From 70 to 73 is only one standard deviation away, which is 34% because it is half of the normal 68%. Then, you just have to add up 50% and 34% to get 84% or 0.84 as the probability. To find P (61<x<73) using the z-table, you just have to do what we did for the last two examples of how to find a probability and fill in the values for this probability problem. So, z ≤ -3 and z ≤ 1 which makes z = .0013 and z = .8413 looking at the table, and then you would do .8413- .0013 for the probability of 0.84. For the graphing calculator, you would just plug this problems values into normalcdf like I’ve already detailed how to do in this paper when talking about the previous probabilities. For this, 61 is the lower value, 73 is the upper value, 70 is the mean, and 3 is the standard deviation. The answer would then be .8399947732 or about .84 when rounded upwards.

The Empirical Rule can be used for P (55 < x < 67) because when you look at the graph and shade in between 55 and 67, there is still a clear number you can get. You just need to follow what I did in steps in the paragraph above to get the correct answer, which for this is also 84% or 0.84. To find P (55<x<67) using the z-table, you just need to follow what has already been laid out and implemented in the first three examples of trying to find the probability. So,

z ≤ -3 and z ≤ 1 which makes z =.0013 and z = .8413 and the probability would be 0.84 by subtraction just like the adult male heights. For the graphing calculator, you plug these values into normalcdf like I’ve detailed how to do in the previous probabilities in this paper. For this one 55 is the lower value, 67 is the higher value, 64 is the mean, and 3 is the standard deviation. The answer would then be .8399947732 or about .84 when rounded upwards, like the adult male heights.

I noticed that the answers in the two paragraphs before this were exactly the same even though they were for different normal distributions. It is for the same reason as the two different probability distributions from earlier, of different values for x, mean, and standard deviation getting the same z-scores of -3 and 1 for both heights. This then made the actual z’s and the probability for both heights be the same.

I prefer using the graphing calculator because it is easier to put everything in that is needed and let the calculator compute the approximate answer that is right. It also eliminates a few steps that are needed when the z-table is used, so the process is quicker. The benefits of using the z-table over the graphing calculator are that it makes it relatively easy to find the area you are looking for after you have calculated your z and that it has any normal random variable from -3 to 3 which makes it easier for you to find what you need for finding a probability.

To find the z-value that has 80% of the area under the standard normal curve to the left of it, I used

invNorm on the calculator. To get to invNorm, you hit 2nd, then go to vars and it is the 3rd option. Then,

you type in the area, which for us is .80 or 80%; and then the mean and standard deviation which are 0

and 1 for us because it is a standard normal curve. When you enter this it shows us that the z-value is

0.8416 when the 1st 4 values are rounded, which could also round to 0.84 if we wanted fewer values.

To find the adult male height that corresponds to this z, you multiply this z by the standard deviation

which is 3 for the x-distribution, and then add the mean which is 70 for this x-distribution. The answer is

the adult male height of 72.52 which would round up to 73 inches for a full number. For the adult female

height it is the same formula and values except for the mean being 64 for the x-distribution. The answer for

adult female height is 66.52 which wound round up to 67 inches as a full number.