How to compute probability with mean and standard deviation

Standard normal distribution is a normal distribution with a zero and standard deviation medium of 1. The standard normal distribution is concentrated at zero and the degree in which a devious data from the average is given by the standard deviation. For standard normal distribution, 68% of the observations are within a standard deviation of the average; 95% are located within two standard deviations of the average; and 99.9% are located within 3 standard deviations of the average. At this point, we used "X" to indicate the interest variable (e.g., X=BMI, X=height, X=weight). However, when using a standard normal distribution, we will use "Z" to refer to a variable in the context of a standard normal distribution. After standarization, the BMI=30 discussed on the previous page is shown below that it is located 0.16667 units above the average of 0 on the standard normal distribution on the right. ♪ Since the area under the standard curve = 1, we can begin to define more precisely the chances of specific observation. For any Z-score data, we can calculate the area under the left curve of the Z-score. The table in the frame below shows the probability for standard normal distribution. Examine the table and note that a "Z" score of 0.0 lists a probability of 0.50 or 50%, and a "Z" score of 1, which means a standard deviation above the middle, lists a probability of 0,8413 or 84%. This is because a standard deviation above and below average includes about 68% of the area, so a standard deviation above the average represents half that of 34%. So, 50% below average plus 34% above average gives us 84%. Probability of standard Z distribution This table is arranged to provide the area under the left curve of a specified value or "Z value". In this case, because the medium is zero and thestandard is 1, the Z value is the number of standard deviation units away from the average, and the area is the probability ofa value less than that particular Z value. Note also that the table shows probability at two decimal points of Z. The place of the units and the first decimal place are shown in the column of the left hand, and the second decimal place is displayed in the upper row. But let us return to the question of the probability that BMI is less than 30, that is, P(X4/30). We can answer this question using standard normal distribution. The figures below show BMI distributions for men aged 60 years and standard side distribution. Distribution of BMI and standard normal distribution ==== The area under each curve is one but the scale of the X axis is different. Note, however, that the areas on the left of the dotted line are the same. The BMI distribution ranges from 11 to 47, while the standardized normal distribution, Z, ranges from -3 to 3. We want to calculate P(X < 30). To do this we can determine the Z value that corresponds to X = 30 and then use the standard normal distribution table above to find the probability or area under the curve. The following formula converts an X value to a Z score, also called a standardized score: where μ is the medium and σ is the standard deviation of the variable X. In order to calculate P(X < 30) we convert the X=30 to the corresponding Z score (this is called standardization): Thus, P(X < 30) = P(Z < 0.17). We can therefore look for the corresponding probability for this Z score from the standard normal distribution table, which shows that P(X < 30) = P(Z < 0.17) = 0.5675. Thus, the probability that a male between 60 has BMI less than 30 is 56.75%. Another example Using the same distribution for BMI, what is the probability that a male aged between 60 years has BMI over 35? In other words, what is P(X > 35)? Once again we standardize: Now we're going to thestandard normal distribution to look for P(Z>1) and for Z=1.00 we find that P(Z¸1.00) = 0.8413. Note, however, that the table always gives the probability that Z is lower than the specified oneThat is, it gives us P(Z 1)=1-0.8413=0. 1587. Interpretation: Almost 16% of men aged between 60 years have BMI over 35. Normal Probability Calculator Z-Scores with R As an alternative to searching for normal odds in the table or using Excel, we can use R to calculate probability. For example, > pnorm(0) [1] 0.5 A Z-score of 0 (the medium of any distribution) has 50% of the area on the left. What is the probability that a man of 60 years in the population above has a BMI below 29 (the middle)? The Z-score would be 0, and pnorm(0)=0.5 or 50%. What is the probability that a 60-year-old man will have a BMI below 30? Z-score was 0.16667. > pnorm(0.16667) [1] 0.5661851 Therefore, the probacity is 56.6%. What is the probability that a 60-year-old man will have a BMI higher than 35? 35-29=6, which is a standard deviation above the average. So we can calculate the area on the left > pnorm(1) [1] 0.8413447 and then subtract the result from 1.0. 1-0.8413447= 0.1586553 So the probability of a 60-year-old man who has a BMI greater than 35 is 15.8%. Or, we can use R to calculate the whole thing in one step as follows: > 1-pnorm(1) [1] 0.1586553 Probability for a range of values What is the probability that a 60-year-old male has BMI between 30 and 35? Note that this is the same as asking which percentage of men aged between 60 years are BMI between 30 and 35. In particular, do we want P(30 < X < 35)? Previously we calculated P(30 280) Now, draw a photo. Remember the center of this normal curve is 272. Figure for example \(\PageIndex{1}\)b To find the probability on the TI-83/84, looking at the image you realize that the lower limit is 280. The upper limit is the infinite. The calculator does not have the infinite on it, so it is necessary to put in a really large number. Some people like to put in 1000, but if you are working with numbers that are larger than 1000, then you should remember to change the upper limit. The safest number to use is \(1 \times 10^{99}\), which fits into the calculator as 1E99 (where E is the EE button on the calculator). The command appears: \(\text{normalcdf}(280,1 E 99,272,9)\) Figure \(\PageIndex{3}\): TI-83/84 Exit for example \(\PageIndex{1}\)b To find the probability on R, R always gives the probability to the left of the value. The total area under the curve is 1, so if you want the area to the right, then you will find the area to the left and subtract from 1. The command appears: \(1-\text { pnom }(280,272,9)\) Thus, \(P(x>280)\approx 0.187\) Thus 18.7% of all pregnancies last more than 280 days. This is not unusual because the probability is greater than 5%. c. First translate the statement into a mathematical statement. P (x