

Continuous Random Variables and the Normal Distribution

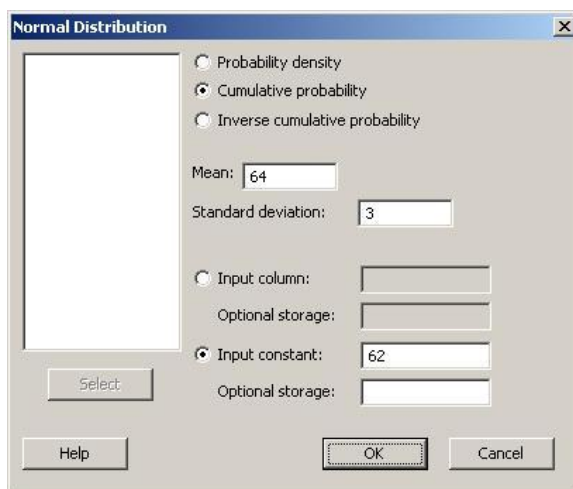
Chapter

6

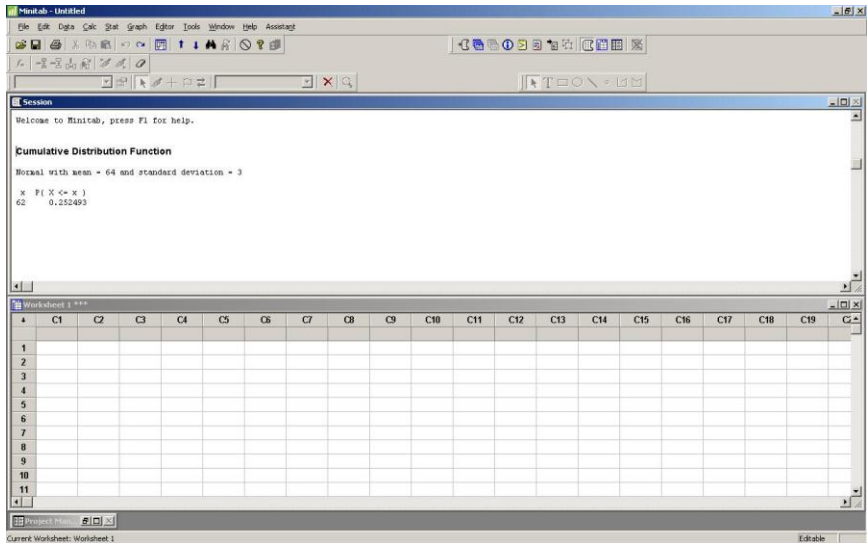
Finding Probabilities for Values in a Normal Distribution

Assume that the height of women follows a normal distribution with a mean of 64 inches and a standard deviation of 3 inches. What is the probability that a randomly selected woman will have a height less than 62 inches?

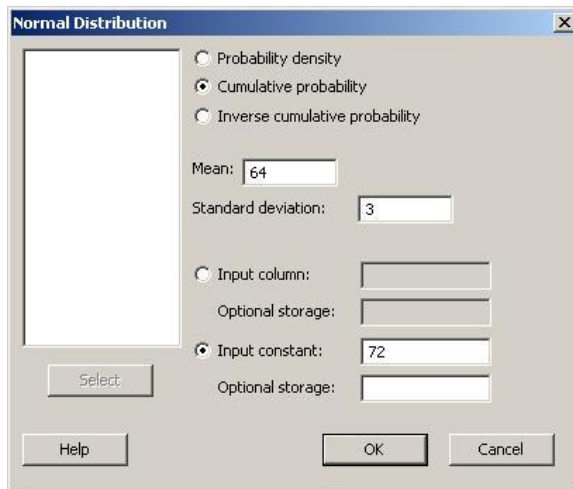
To calculate this in Minitab, click on **Calc** → **Probability Distributions** → **Normal**. Select the circle next to **Cumulative probability**. (Cumulative probability 'accumulates' all probability to the left of a specific value). Enter 64 for the **Mean** and 3 for the **Standard deviation**. Select the circle next to **Input Constant** and enter 62 in the field. Click **OK**.



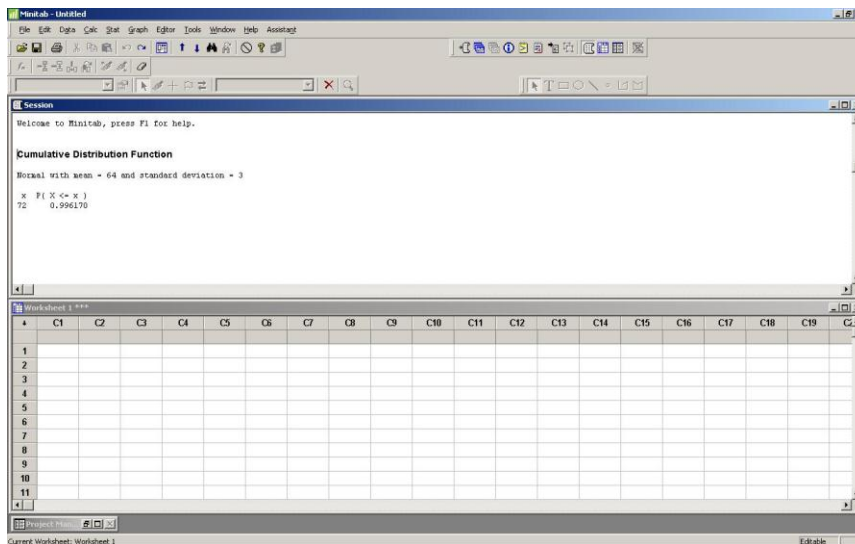
The Normal probability $P(X \leq 62)$ will be displayed in the Session Window. The probability that a woman will have a height less than 62 inches is 0.252493.



What is the probability that a randomly selected woman will have a height more than 72 inches? To calculate this in Minitab, click on **Calc** → **Probability Distributions** → **Normal**. Select the circle next to **Cumulative probability**. Enter 64 for the **Mean** and 3 for the **Standard deviation**. Select the circle next to **Input Constant** and enter 72 in the field. Click **OK**.



The Normal probability $P(X \leq 72)$ will be displayed in the Session Window.



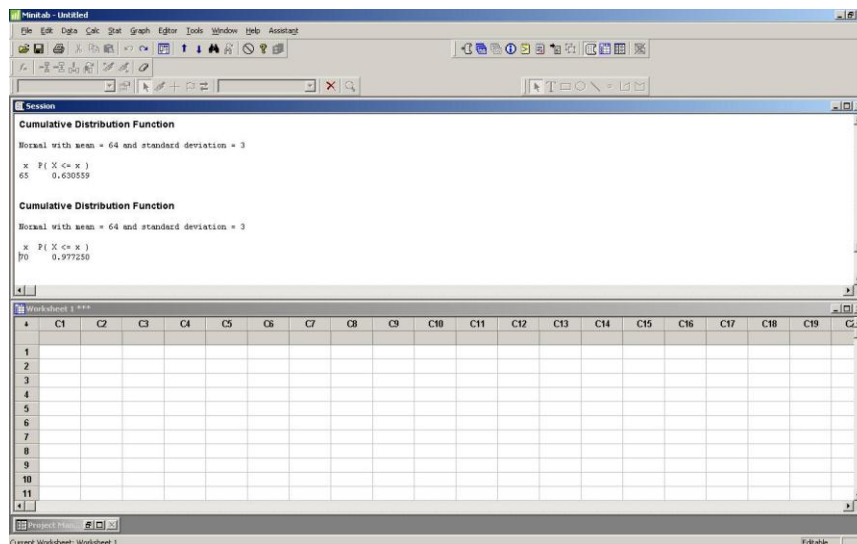
However, the question asked the probability that a woman have a height *more than* 72 inches. In order to calculate this, subtract the displayed value from 1, since $P(X > 72) = 1 - P(X < 72)$. Therefore, the probability that a woman will have a height over 72 inches is $1 - 0.996170$, or 0.00383.

What is the probability that a randomly selected woman will have a height between 65 and 70 inches? To calculate this in Minitab, you will need to first calculate the probabilities for both less than 65 and less than 70 inches.

To calculate the probability that a woman is less than 65 inches click on **Calc** → **Probability Distributions** → **Normal**. Select the circle next to **Cumulative probability**. Enter 64 for the **Mean** and 3 for the **Standard deviation**. Select the circle next to **Input Constant** and enter 65 in the field. Click **OK**.

Next, to calculate the probability that a woman is less than 70 inches click on **Calc** → **Probability Distributions** → **Normal**. Select the circle next to **Cumulative probability**. Enter 64 for the **Mean** and 3 for the **Standard deviation**. Select the circle next to **Input Constant** and enter 70 in the field. Click **OK**.

Both probabilities should be displayed in the session window.



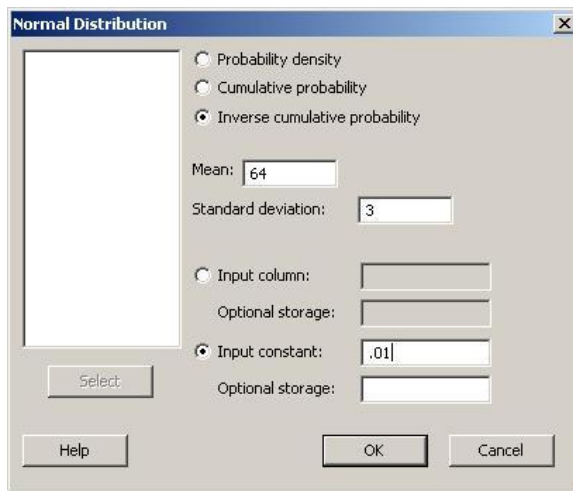
To find the probability *between* 65 and 70, you must subtract the two probabilities.

$$P(65 < X < 70) = P(X < 70) - P(X < 65), \text{ therefore}$$

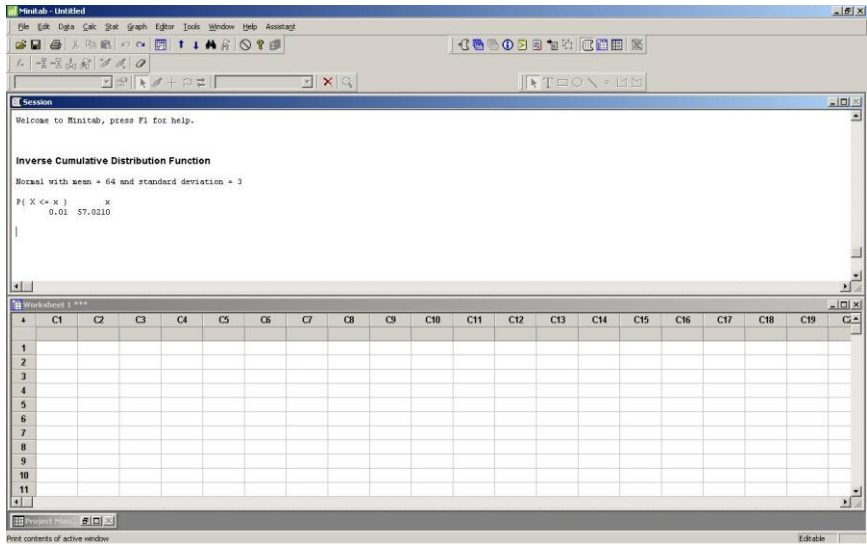
$P(65 < X < 70) = 0.977250 - 0.630559 = 0.346691$. Therefore, the probability a woman will have a height between 65 and 70 inches is 0.346691.

Finding a Specific Data Value Using the Normal Curve

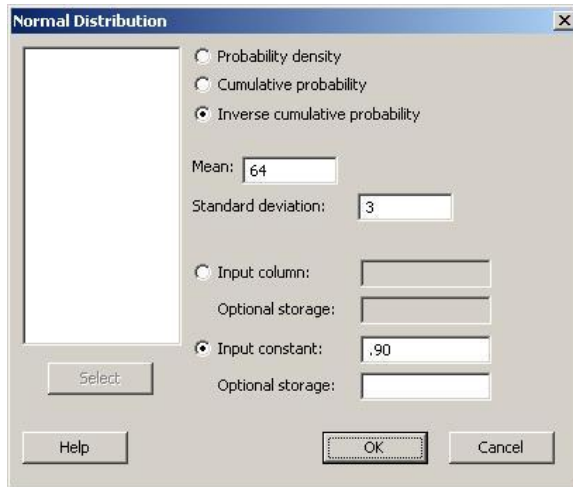
Assume that the height of women follows a normal distribution with a mean of 64 inches and a standard deviation of 3 inches. Only 1% of all women are below what height? To find this height, in Minitab, click on **Calc** → **Probability Distributions** → **Normal**. Select the circle next to **Inverse Cumulative probability**. Enter 64 for the **Mean** and 3 for the **Standard deviation**. Select the circle next to **Input Constant** and enter .01 in the field, to represent the bottom 1% of the distribution. Click **OK**.



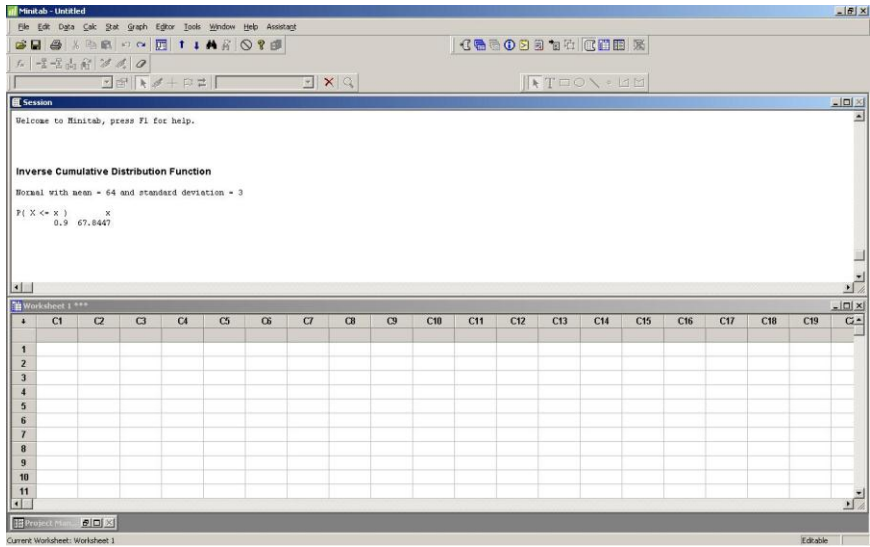
The X-value that represents the cut-off point for the bottom 1% of the distribution will be displayed in the session window. Therefore, 1% of women are less than 57.0210 inches.



Assume that the height of women follows a normal distribution with a mean of 64 inches and a standard deviation of 3 inches. Only 10% of all women are above what height? To find this height, in Minitab, click on **Calc** → **Probability Distributions** → **Normal**. Select the circle next to **Inverse Cumulative probability**. Enter 64 for the **Mean** and 3 for the **Standard deviation**. Select the circle next to **Input Constant** and enter .90 in the field. Remember, the input constant will be the area to the left of the X -value desired. Since we want the value that separates the top 10% from the bottom 90%, you must enter .90 for the bottom 90% of the distribution. Click **OK**.



The X -value that represents the cut-off point for the top 10% of the distribution will be displayed in the session window. Therefore, 10% of women are more than 67.8447 inches.



Suggested Exercises

Section 6.1

6.15, 6.19, 6.25

Section 6.2

6.31, 6.33, 6.35

Section 6.3

6.37, 6.39, 6.41, 6.43, 6.47, 6.49

Section 6.4

6.57, 6.59, 6.61

Section 6.5

6.69, 6.75

Supplementary Exercises

6.81, 6.83, 6.85, 6.87, 6.95

Technology Assignments

TA 6.3, TA 6.5