

4.3 Normal probability using Excel Spreadsheet provided and Excel only

To download the Excel workbook for Continuous Probability Distribution Function, [click here](#).

Definition: Normal Probability Distribution

Suppose a random variable X is Distributed Normal with a mean of 120 and a standard deviation of 13, $X \sim N(120, 13)$. Compute the following values. Round the probabilities to 4 decimal places. Round the X values and Z scores to 2 decimal places.

1. $P(X > 134)$
2. $P(X < 110)$
3. $P(90 < X < 123)$
4. Find the 56th percentile.
5. The value -2.2 standard deviations below the mean.
6. The value 1.56 standard deviations above the mean.
7. Find the Z score that has a lower probability of .35.
8. Find the Z score that has an upper probability of .54.

To find the $P(X > 134)$ remember it is $1 - P(X < 134)$. Enter the following formulas.

$$=1 - \text{norm.dist}(134, 120, 13, \text{true}) = 0.14075732$$

Make sure you round the answer to four decimal places, 0.1408.

To find the $P(X < 110)$. Enter the following formula.

$$= \text{norm.dist}(110, 120, 13, \text{true}) = 0.22087816$$

Make sure you round the answer to four decimal places, 0.2209.

To find the $P(90 < X < 123)$. Enter the following formula.

$$= \text{norm.dist}(123, 120, 13, \text{true}) - \text{norm.dist}(90, 120, 13, \text{true}) = 0.58074483$$

Make sure you round the answer to four decimal places, 0.5807.

To find the 56th percentile, enter the following formula.

$$= \text{norm.inv}(.56, 120, 13) = 121.9626$$

Make sure you round the answer to four decimal places, 121.96.

To find the X value that is -2.2 standard deviation below the mean, enter the following formula.

$$= \text{Mean} + Z * \text{standard deviation}$$

$$= 120 + (-2.2) * 13 = 91.4$$

Make sure you round the answer to two decimal places, 91.40.

To find the X value that is 1.56 standard deviations above the mean, enter the following formula.

$$= \text{Mean} + Z * \text{standard deviation}$$

$$= 120 + 1.56 * 13 = 140.28$$

Make sure you round the answer to two decimal places, 140.28.

The Z score has a mean of 0 and a standard deviation of 1. To find the lower probability of .35 (from left to right), enter the following formula.

$$= \text{norm.inv}(.35, 0, 1) = -0.3853205$$

Make sure you round the answer to two decimal places, -0.39.

To find the Z score that has an upper probability of .54 you must first subtract .54 from 1, 0.46. Then enter the following formula.

=norm.inv(0.46, 0, 1) = -0.1004337

Make sure you round the answer to two decimal places, -0.10.

✓ Example 1

Using the Excel Spreadsheet provided

Click on the **Normal Probability Distribu (2)** tab at the bottom. Enter the mean in cell B1, 120. Enter the standard deviation in cell B2, 13.

- 1) To compute $P(X > 134)$, enter 134 in cell B7, 0.1408.
- 2) To compute $P(X < 110)$, enter 110 in cell B8, 0.2209.
- 3) To compute $P(90 < X < 123)$, enter 90 in cell B7 and 123 in cell B8. The answer is in cell B9, 0.5807.
- 4) To compute the 56th percentile, enter .56 in cell E1. The answer is in cell E2, 121.96.
- 5) To find the X value that is -2.2 standard deviation below the mean first change the mean to 0 and the standard deviation to 1. Then enter -2.2 in cell B5. Then note the probability in cell B8, .0139. Enter 0.01039 in cell E1. Then change the mean to 120 and the standard deviation to 13. The X value is in cell E2, 91.40 (*Rounded to two decimal places*).
- 6) To find the X value that is 1.56 standard deviation above the mean first change the mean to 0 and standard deviation to 1. Then enter 1.56 in cell B5. Then note the probability in cell B8, 0.9406. Enter 0.9406 in cell E1. Then change the mean to 120 and the standard deviation to 13. The X value is in cell E2, 140.28 (*Rounded to two decimal places*).
- 7) To find the Z score that has a lower probability of .35. Change the mean to 0 and the standard deviation to 1. Then enter 0.35 in cell E1. The Z score is in E2, -.38532. Rounded to two decimal places the Z score is -0.39.
- 8) To find the Z score that has an upper probability of 0.54. First, subtract 0.54 from 1 to get 0.46. Enter 0.46 in cell E1. Change the mean to 0 and standard deviation to 1. The answer is in cell E2, -.10043. Round the answer to two decimal places, -0.10.

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