



Week 5: Probability Distributions

## Unit 4: Using the Normal Distribution to Calculate Probability

# Using the Normal Distribution to Calculate Probability

## Normal distribution recap

### Normal Curve

Smaller Standard Deviation



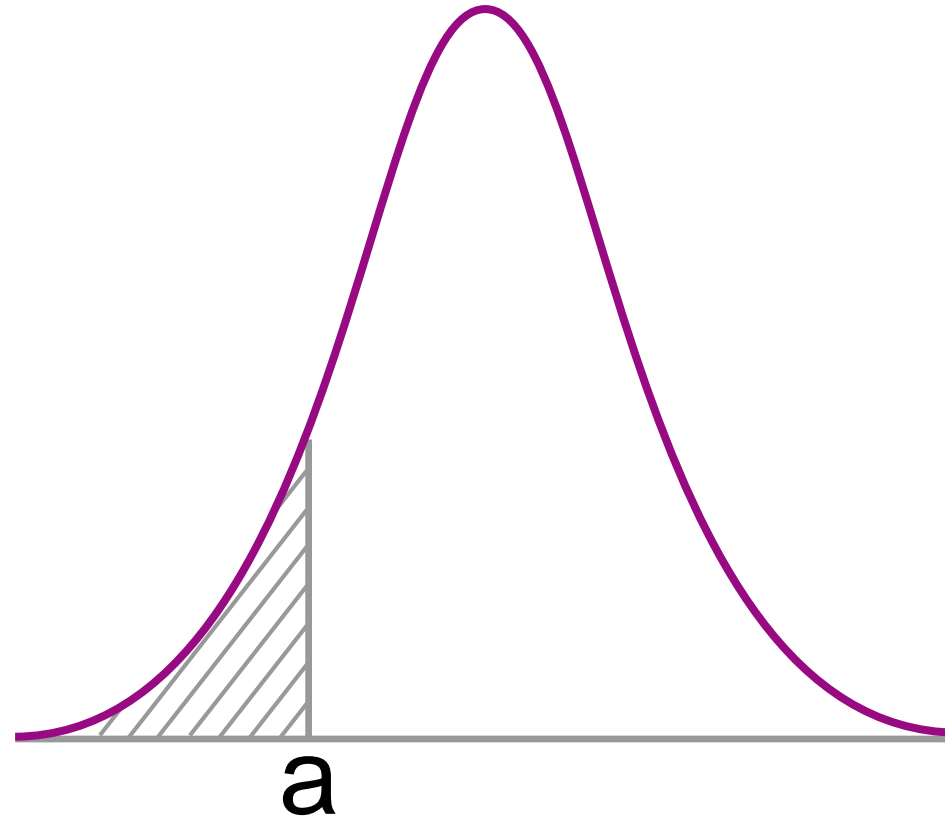
### Normal Curve

Larger Standard Deviation



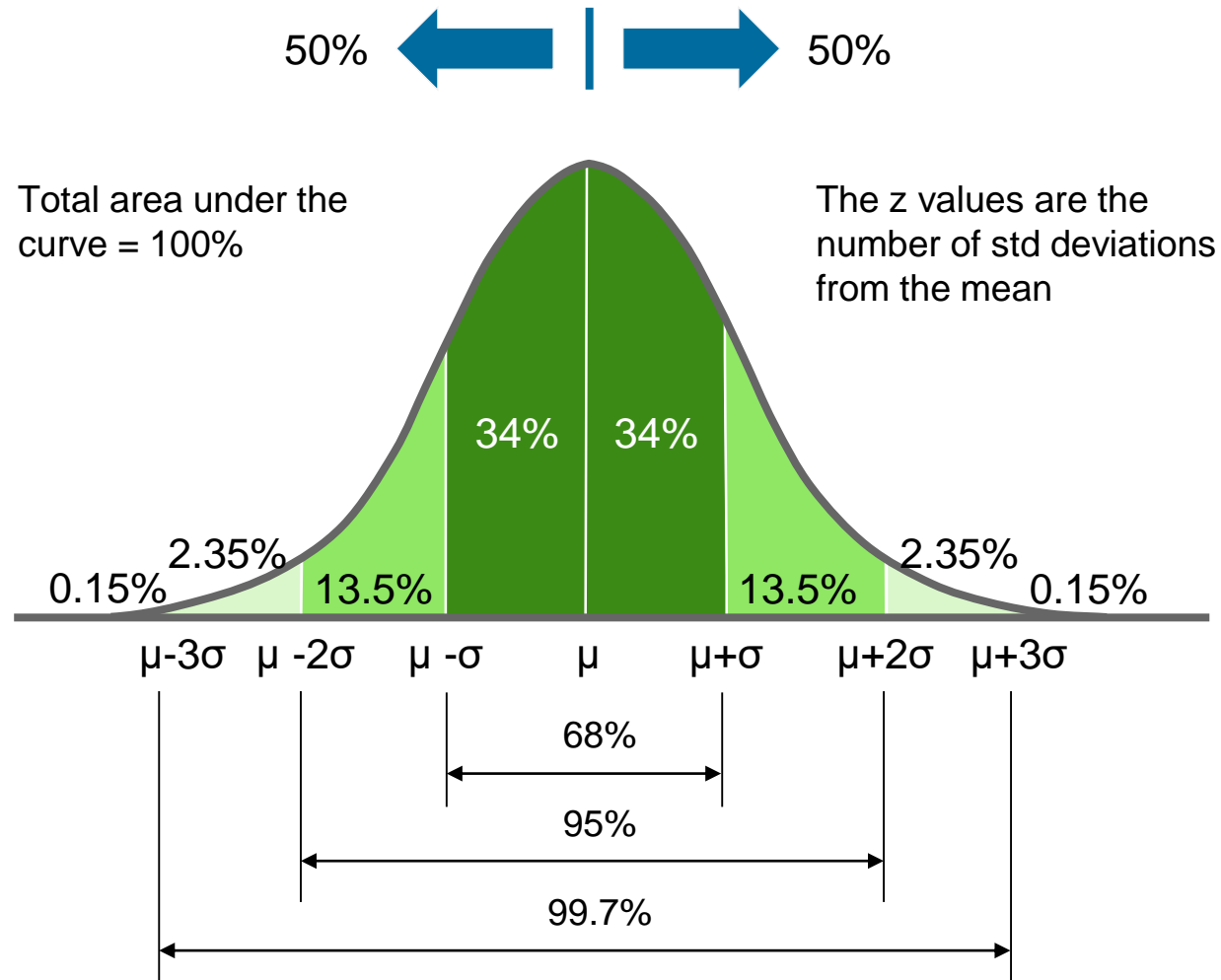
# Using the Normal Distribution to Calculate Probability

## Probability and the normal distribution recap



# Using the Normal Distribution to Calculate Probability

## Empirical rule recap

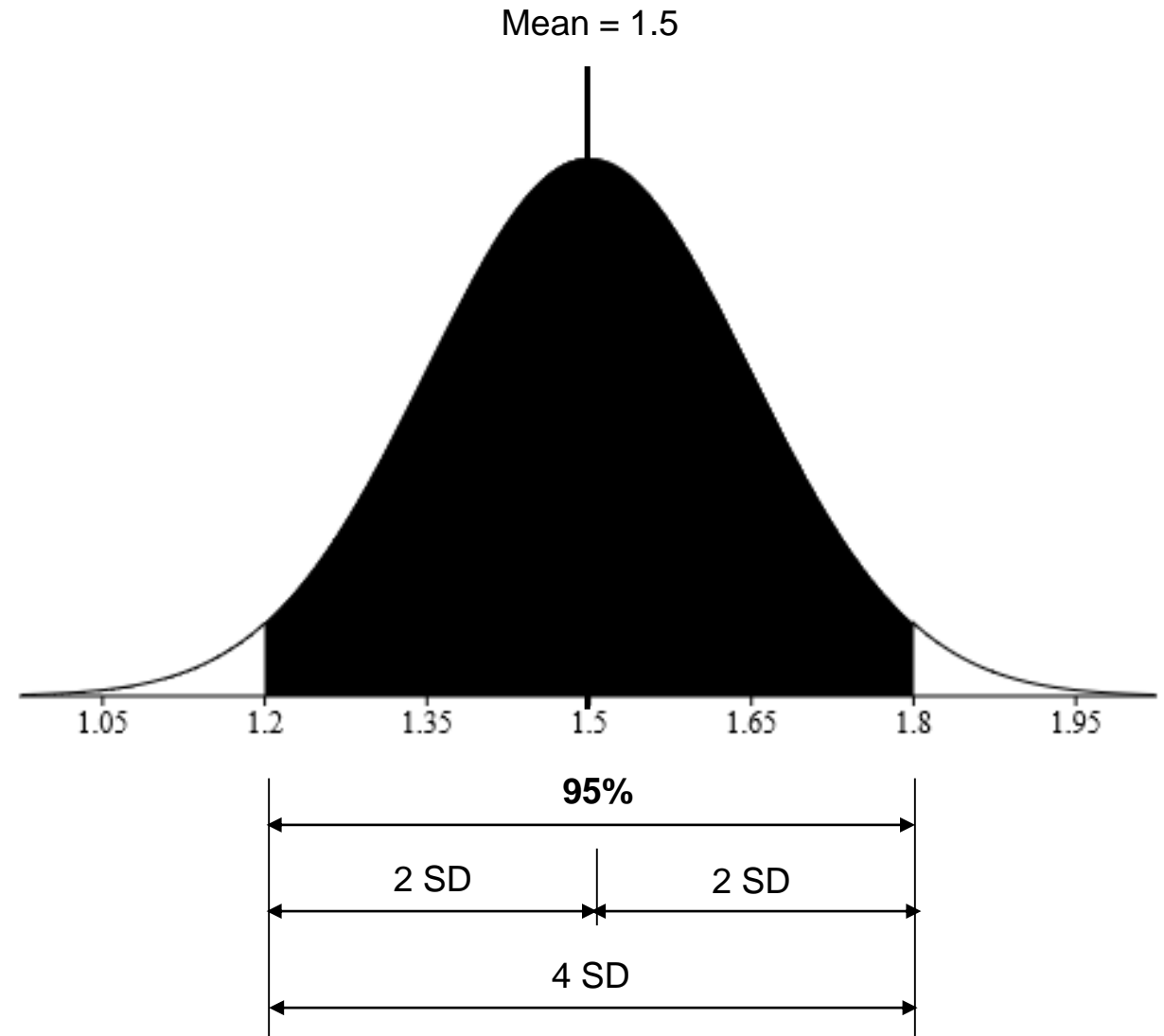


# Using the Normal Distribution to Calculate Probability

## Empirical rule example

### Question

- 95% of students at school are between 1.2m and 1.8m tall.
- Assuming this data is normally distributed, calculate the mean and standard deviation.

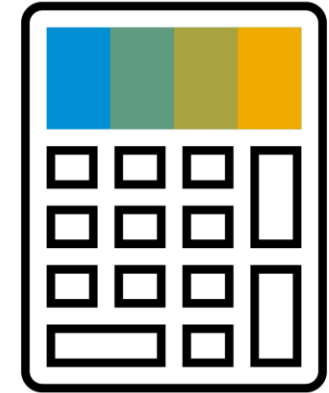


[http://davidmlane.com/hyperstat/z\\_table.html](http://davidmlane.com/hyperstat/z_table.html)

## Using the Normal Distribution to Calculate Probability

### Find probabilities

- How can you use this theory in practice?
- To find the probability associated with a normal random variable, use a graphing calculator, an online normal distribution calculator, or a normal distribution table.
- There are lots of normal distribution calculators available online.



- Here are some examples for you:

<https://www.mathportal.org/calculators/statistics-calculator/normal-distribution-calculator.php>

<https://stattrek.com/online-calculator/normal.aspx>

<https://www.hackmath.net/en/calculator/normal-distribution>

[http://davidmlane.com/hyperstat/z\\_table.html](http://davidmlane.com/hyperstat/z_table.html)

# Using the Normal Distribution to Calculate Probability

## Example 1

### Question

- On average, a light bulb lasts 300 days with a standard deviation of 50 days.
- Assuming that bulb life is normally distributed, what is the probability that the light bulb will last at most 365 days?

### Normal distribution calculator

Enter mean (average), standard deviation and cutoff points and this normal distribution calculator will calculate the area (=probability) under normal distribution curve.

Enter parameters of normal distribution:

Mean

Standard deviation

☐ Above

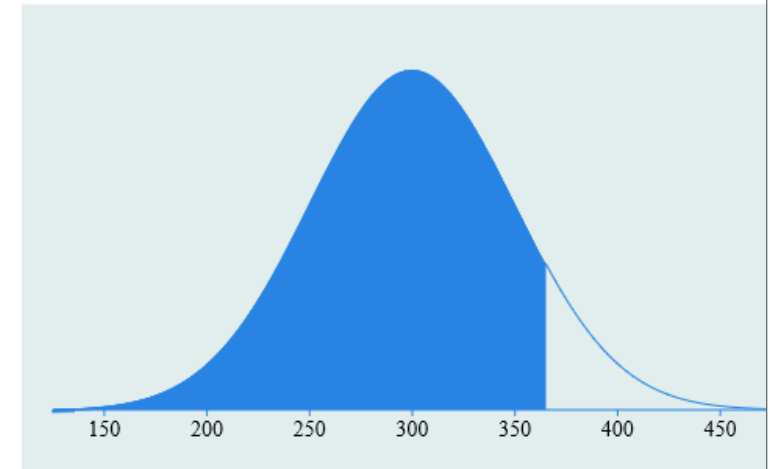
☒ Below

☐ Between  and

☐ Outside  and

Result:

Area (probability) = 0.9032



<https://www.hackmath.net/en/calculator/normal-distribution>

<https://www.hackmath.net/en/calculator/normal-distribution?mean=300&sd=50&above=&area=below&below=365&ll=&ul=&outsideLL=&outsideUL=&draw=Calculate>

# Using the Normal Distribution to Calculate Probability

## Example 2

### Question

- Scores on an IQ test are normally distributed.
- If the test has a mean of 110 and a standard deviation of 20, what is the probability that a person who takes the test will score between 90 and 120?

### Normal distribution calculator

Enter mean (average), standard deviation and cutoff points and this normal distribution calculator will calculate the area (=probability) under normal distribution curve.

Enter parameters of normal distribution:

Mean

110

Standard  
deviation

20

☐ Above

☐ Below

☒ Between

☐ Outside

90

and

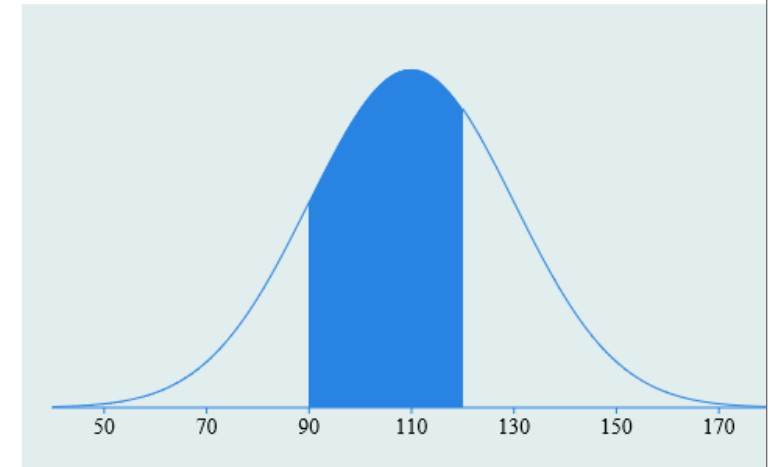
120

and

Calculate

Result:

Area (probability) = 0.5328



<https://www.hackmath.net/en/calculator/normal-distribution?mean=110&sd=20&above=&below=&area=between&ll=90&ul=120&outsideLL=&outsideUL=&draw=Calculate>



## Using the Normal Distribution to Calculate Probability

### Example 3

#### Question

- A student achieved a score of 900 in an exam.
- The mean test score was 825 with a standard deviation of 100.
- Assuming that test scores are normally distributed, what proportion of students achieved a higher score than 900?

#### Normal distribution calculator

Enter mean (average), standard deviation and cutoff points and this normal distribution calculator will calculate the area (=probability) under normal distribution curve.

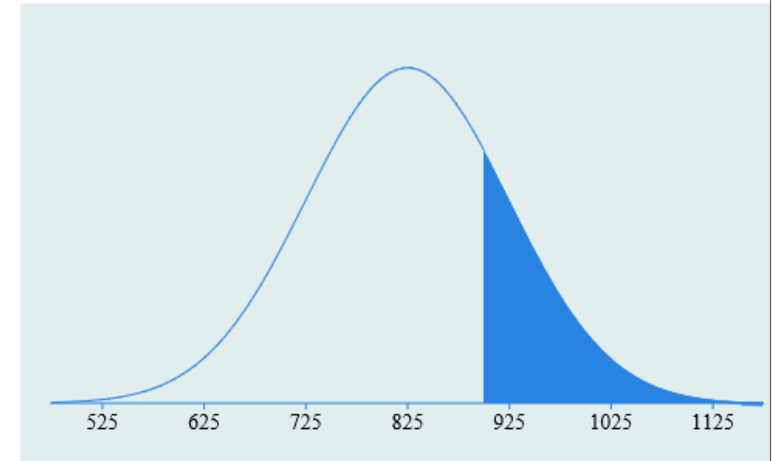
Enter parameters of normal distribution:

Mean	<input type="text" value="825"/>
Standard deviation	<input type="text" value="100"/>
<input checked="" type="radio"/> Above	<input type="text" value="900"/>
<input type="radio"/> Below	<input type="text"/>
<input type="radio"/> Between	<input type="text"/> and <input type="text"/>
<input type="radio"/> Outside	<input type="text"/> and <input type="text"/>

Calculate

Result:

Area (probability) = 0.2266



<https://www.hackmath.net/en/calculator/normal-distribution?mean=825&sd=100&area=above&above=900&below=&ll=&ul=&outsideLL=&outsideUL=&draw=Calculate>

## Using the Normal Distribution to Calculate Probability

### Summary

- The **normal distribution** refers to a family of continuous probability distributions.
- The area under the normal distribution curve can be used to calculate probabilities for a normally distributed random variable.
- There are lots of normal distribution calculators available online. Given the mean and standard deviation, the calculator can be used to calculate the area under the normal curve (the probability):
  - less than a value
  - greater than a value
  - between values
  - outside two values

<https://stattrek.com/probability-distributions/normal.aspx>

<https://www.mathsisfun.com/data/standard-normal-distribution.html>

<https://statistics.laerd.com/statistical-guides/normal-distribution-calculations.php>



# Thank you.

**Contact information:**

**open@sap.com**

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