PSY 201: Statistics in Psychology

Lecture 09
Normal distribution
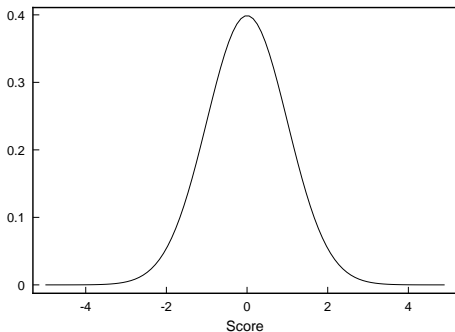### *A statistical approach to assigning grades.*

Greg Francis

Purdue University
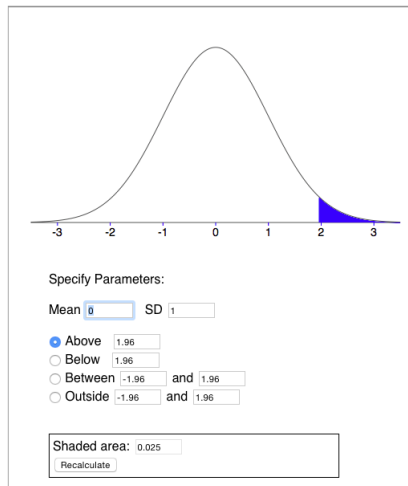
Fall 2019

PERCENTILE RANKS

- area under the curve below a particular score (same as we did before)

PERCENTILE RANKS

Normal Distribution Calculator

- suppose you have a **normal** distribution with a mean of 85 and a standard deviation of 20
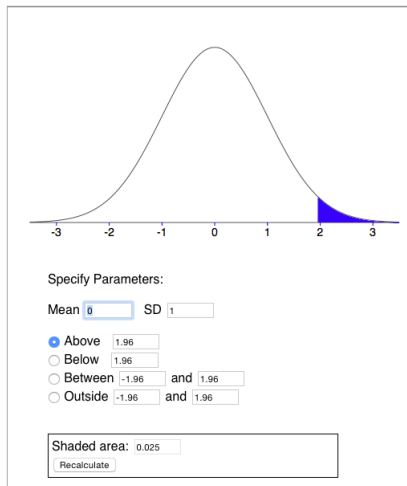- how would you find the percentile rank of raw score 65?

Specify Parameters:

Mean 0   SD 1

- ⦿ Above   1.96
- ◯ Below   1.96
- ◯ Between   -1.96   and   1.96
- ◯ Outside   -1.96   and   1.96

Shaded area: 0.025
Recalculate

EXAMPLE

Normal Distribution Calculator

- A set of 200 scores is normally distributed with a mean of 60 and a standard deviation of 12.
- How many scores lie between the values of 48 and 80? 65 and 75? 34 and 52?
- Normal Distribution Calculator
- **proportion** of scores is area under the curve

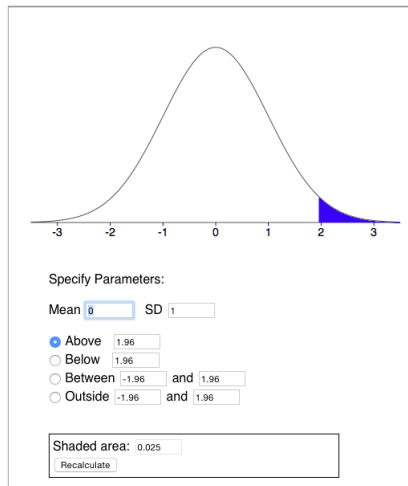Specify Parameters:

Mean $\boxed{0}$ SD $\boxed{1}$

◉ Above $\boxed{1.96}$
○ Below $\boxed{1.96}$
○ Between $\boxed{-1.96}$ and $\boxed{1.96}$
○ Outside $\boxed{-1.96}$ and $\boxed{1.96}$

Shaded area: $\boxed{0.025}$
$\boxed{\text{Recalculate}}$

EXAMPLE

- the area is the **proportion** of scores
- to get the number of scores, we multiply the proportion times the total number of scores
  - number of scores between 48 and 80 is $200 \times 0.7938 = 158.76$
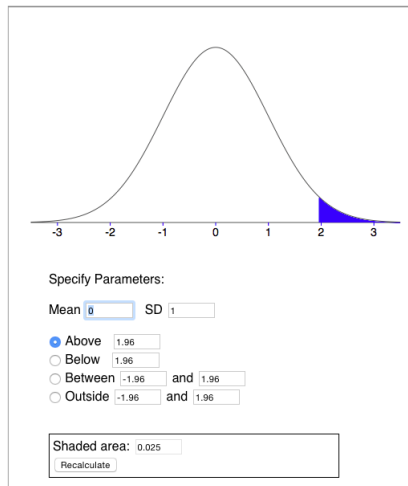- We do the same thing for the other cases...

Normal Distribution Calculator

Specify Parameters:

Mean 0   SD 1

- Above 1.96
- Below 1.96
- Between -1.96 and 1.96
- Outside -1.96 and 1.96

Shaded area: 0.025
Recalculate

EXAMPLE

Normal Distribution Calculator

- To get the number of scores
  between 65 and 75 we calculate:

- Total area $= 0.2316$

  - Number of scores between 65
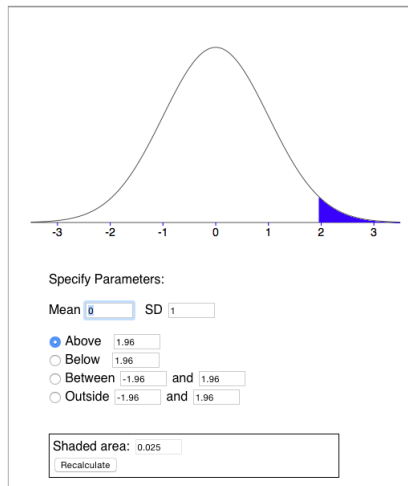   and 75 $=$
    $200 \times 0.2316 = 46.32$

Specify Parameters:

Mean `0`   SD `1`

- Above `1.96`
- Below `1.96`
- Between `-1.96` and `1.96`
- Outside `-1.96` and `1.96`

Shaded area: `0.025`
`Recalculate`

EXAMPLE

Normal Distribution Calculator

- to find scores between 34 and 52 we find that:

- area $= 0.2364$

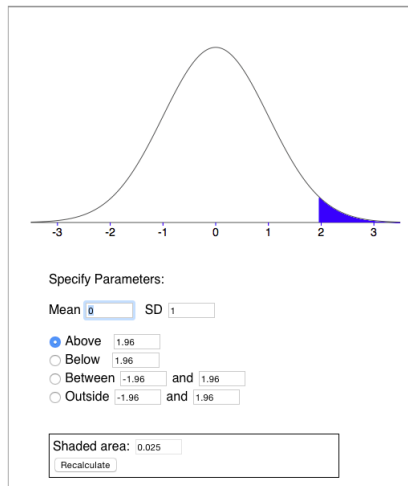 - Number of scores between 34 and $52 =$
    $200 \times 0.2364 = 47.28$

Specify Parameters:

Mean 0 SD 1

- Above 1.96
- Below 1.96
- Between -1.96 and 1.96
- Outside -1.96 and 1.96

Shaded area: 0.025
Recalculate

EXAMPLE

- How many scores exceed the values of 80, 60, and 40?
- area under the normal curve greater than 80 is 0.0475
  - So the number of scores greater than 80 is: $200 \times 0.0475 = 9.5$
- Same approach for the other scores

Normal Distribution Calculator

Specify Parameters:

Mean 0   SD 1

- Above 1.96
- Below 1.96
- Between -1.96 and 1.96
- Outside -1.96 and 1.96
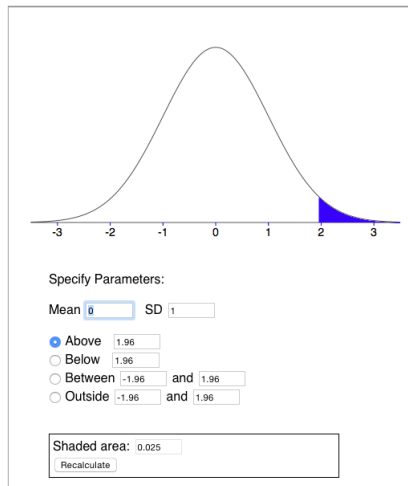
Shaded area: 0.025

Recalculate

EXAMPLE

- area under the normal curve greater than 60 is 0.5
    - so the number of scores greater than 60 is $200 \times 0.5 = 100$.

- area under the normal curve greater than 40 is 0.9525
    - so the number of scores greater than 40 is $200 \times 0.9525 = 190.5$

EXAMPLE

Normal Distribution Calculator

- How many scores are less than the values of 35, 50 and 75?
- area below 35 is 0.0188
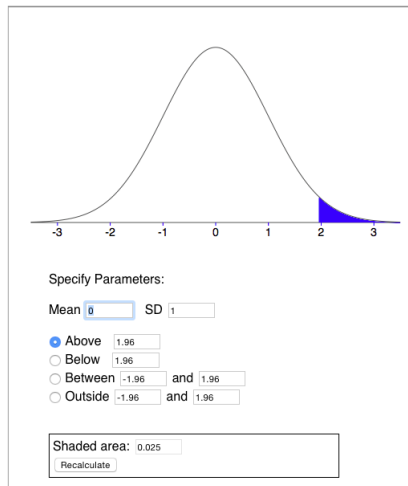 - Number of scores less than 35 is $200 \times 0.0188 = 3.76$

Specify Parameters:

Mean 0 SD 1

- Above 1.96
- Below 1.96
- Between -1.96 and 1.96
- Outside -1.96 and 1.96

Shaded area: 0.025
Recalculate

EXAMPLE

Normal Distribution Calculator

- area below 50 is 0.2033
  - Number of scores less than 50 is $200 \times 0.2033 = 40.66$

- area below 75 is $0.3944 + 0.5 = 0.8944$
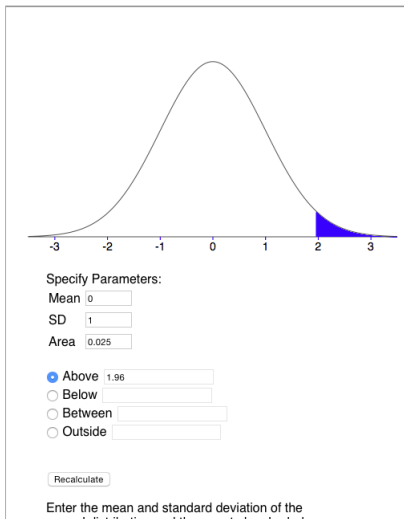 - Number of scores less than 75 is $200 \times 0.8944 = 178.88$

Specify Parameters:

Mean 0   SD 1

- Above 1.96
- Below 1.96
- Between -1.96 and 1.96
- Outside -1.96 and 1.96

Shaded area: 0.025
Recalculate

EXAMPLE

- Find P_{35}, P_{80}, PR_{55}, PR_{70}.
- For percentiles, we use the Inverse Normal Calculator

Inverse Normal Distribution Calculator

Specify Parameters:

Mean 0

SD 1

Area 0.025

- Above 1.96
- Below
- Between
- Outside

Recalculate

Enter the mean and standard deviation of the normal distribution and the area to be shaded.
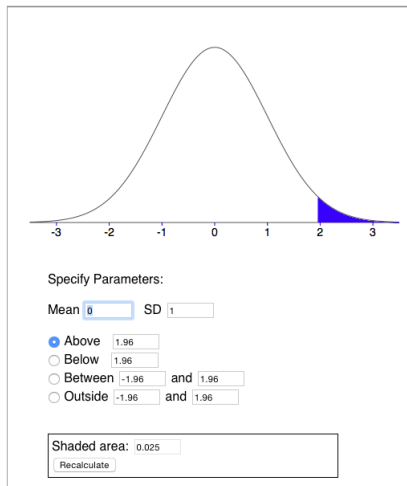
EXAMPLE

- For Percentile Ranks, use the Normal Distribution Calculator
- Find area under the normal for scores **less** than these scores

    area less than 55 → 0.3372

    area less than 70 → 0.7967

- in percentiles these mean:
  - $PR_{55} = 33.72$
  - $PR_{70} = 79.67$

Normal Distribution Calculator

Specify Parameters:

Mean `0` SD `1`

- Above `1.96`
- Below `1.96`
- Between `-1.96` and `1.96`
- Outside `-1.96` and `1.96`

Shaded area: `0.025`
Recalculate

ASSIGNING GRADES

- A statistics instructor tells the class that grading will be based on the normal distribution. He plans to give 10 percent A's, 20 percent B's, 40 percent C's, 20 percent D's, and 10 percent F's.
- If the final examination scores have a mean of 75 and a standard deviation of 9.6, what is the range of scores for each grade?
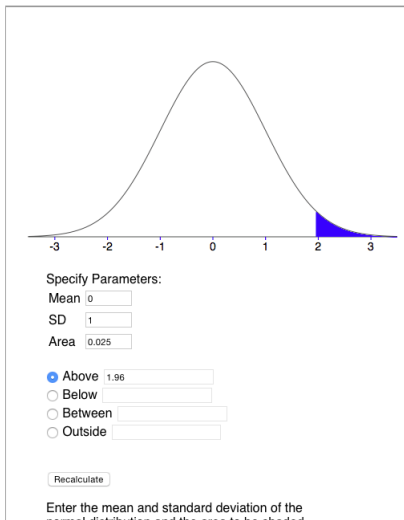
A range

- To find the A range, we need to find what score corresponds to the top 10%.

- Use the Inverse Normal Calculator:

$$P_{90} = 87.30$$

- So the A range is any score greater than 87.30
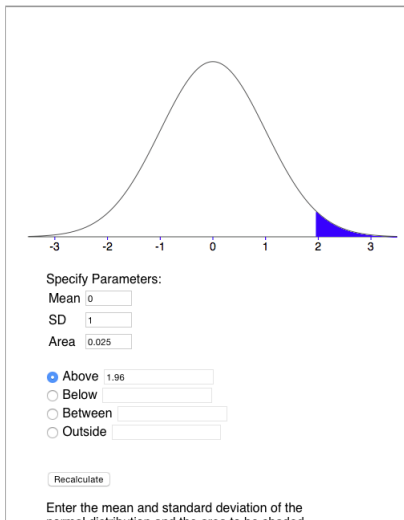
Inverse Normal Distribution Calculator

Specify Parameters:
Mean [0]
SD [1]
Area [0.025]

- Above [1.96]
- Below
- Between
- Outside

[Recalculate]

Enter the mean and standard deviation of the
normal distribution and the area to be shaded

B range

Inverse Normal Distribution Calculator

- B range must include 20% of scores.
- Must be less than 87.30.
- We need to find P_{70}!! (lower limit)

$$P_{70} = 80.03$$

- So the B range is between 80.03 and 87.30

Specify Parameters:
Mean [0]
SD [1]
Area [0.025]

○ Above [1.96]
○ Below
○ Between
○ Outside

[Recalculate]

Enter the mean and standard deviation of the normal distribution and the area to be shaded
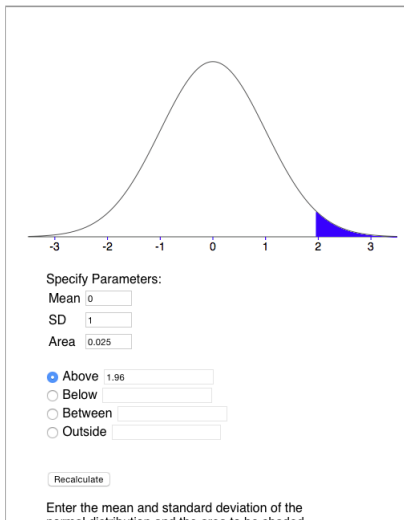
C range

- C range must include 40% of scores.
- Must be less than 80.03.
- We need to find P_{30}!! (lower limit)
- Use the Inverse Normal Calculator:

$$P_{30} = 69.97$$

- So the C range is between 69.97 and 80.03

Inverse Normal Distribution Calculator

Specify Parameters:

Mean `0`

SD `1`

Area `0.025`

- Above `1.96`
- Below
- Between
- Outside

`Recalculate`

Enter the mean and standard deviation of the normal distribution and the area to be shaded.
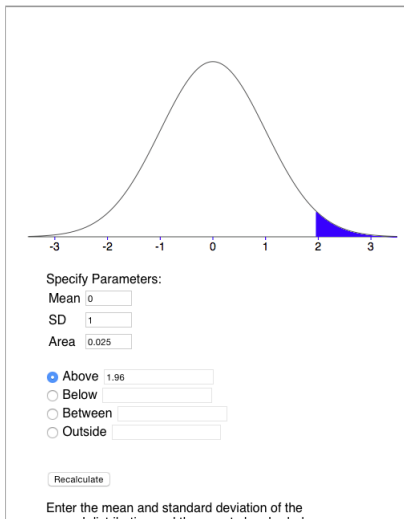
D range

- D range must include 20% of scores.
- Must be less than 69.97.
- We need to find P_{10}!! (lower limit)
- Use the Inverse Normal Calculator:

$$P_{10} = 62.70$$

- So the D range is between 62.70 and 69.97
- of course the F range is anything below 62.70

Inverse Normal Distribution Calculator

Specify Parameters:
Mean 0
SD 1
Area 0.025

● Above 1.96
○ Below
○ Between
○ Outside

[Recalculate]

Enter the mean and standard deviation of the
normal distribution and the area to be shaded

CONCLUSIONS

- the on-line calculator makes these problems fairly easy to compute
- it still takes effort to think about what you actually need
- looking at graphs helps a lot!

NEXT TIME

- correlation
- identifying relationships between data sets

How changes in one variable correspond to change in another variable.