Day 6: Inverse Norm

(Going from Percents to Z-scores)

Finding Normal Percentiles by Hand

- When a data value doesn't fall exactly 1, 2, or 3 standard deviations from the mean, we can look it up in a table of Normal percentiles.
- Table Z in Appendix F provides us with normal percentiles, but many calculators and statistics computer packages provide these as well.

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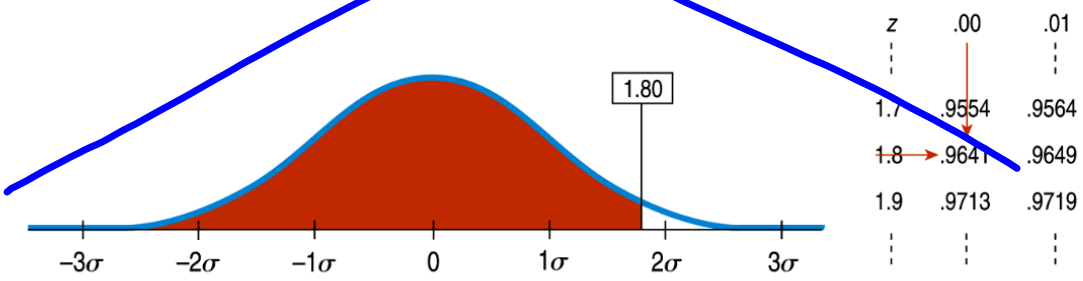
Finding Normal Percentiles by Hand (cont.)

- Table Z is the *standard Normal* table. We have to convert our data to *z*-scores before using the table.
- The figure shows us how to find the area to the left when we have a *z*-score of 1.80:



z	.00	.01
1.7	.9554	.9564
1.8	.9641	.9649
1.9	.9713	.9719

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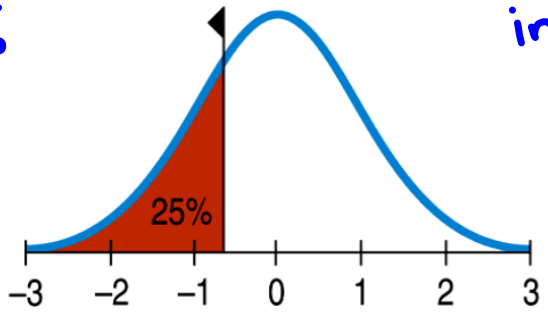
From Percentiles to Scores: *z* in Reverse

(%)

- Sometimes we start with areas and need to find the corresponding *z*-score or even the original data value.
- Example: What *z*-score represents the first quartile in a Normal model?

Q1 = 25%

invnorm (.25)
-.674



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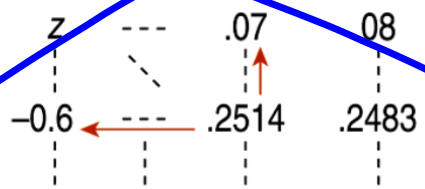
From Percentiles to Scores: *z* in Reverse (cont.)

- Look in Table Z for an area of 0.2500.
- The exact area is not there, but 0.2514 is pretty close.



- This figure is associated with $z = -0.67$, so the first quartile is 0.67 standard deviations below the mean.

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Finding Normal Percentiles Using Technology

- Many calculators and statistics programs have the ability to find normal percentiles for us.
- Enter the lower bound and upper bound as z-scores into your calculator's normalcdf (cumulative distribution function) and your calculator will compute the percentage between the z-scores.
- Enter a percentile into your calculator's inverse-normal command and it will provide you with the corresponding z-score.

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What if you're given the percent below or above a specific value and you need to find the value, mean or standard deviation?

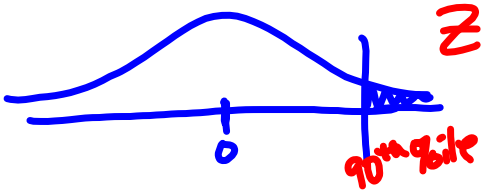
Answer: You work backwards!

You will be using the invNorm function:

2^{nd}-->vars-->3:invNorm(percent as a decimal BELOW a specific value) pg.39

- invNorm tells you the z-score that corresponds to a percent BELOW a value
  - If they tell you a percent ABOVE a value, you have to subtract it from 1 before entering into invNorm on calculator

Example 1: Scores on SAT Verbal are Normally Distributed with a mean of 505 and a standard deviation of 110. How high must a student score to be in the top 10%?



$z = \text{invnorm}(.9) = 1.28$

$z = \frac{\text{value} - \text{mean}}{SD}$

$\frac{1.28}{1} = \frac{x - 505}{110}$

$140.8 = x - 505$

$x = 645.8 \approx 646$

Example 2: Given a normal distribution of $\sigma = 10$ (S.D.), what is the mean ($\bar{x}$) if 21% of values are below 50? (Value, %ile)

$z = \text{invnorm}(.21) = -.806$

$z = \frac{\text{Value} - \text{mean}}{\text{S.D}}$

$\frac{-.806}{1} = \frac{50 - \bar{x}}{10}$

$-8.06 = 50 - \bar{x}$

$-58.06 = -\bar{x}$

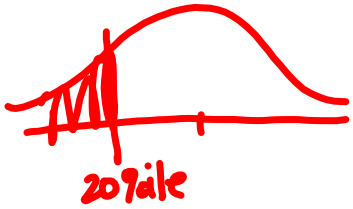
$58.06 = \bar{x}$

Example 3: Based on a Normal distribution model of Angus steer weights with a mean of 1152 lbs and a standard deviation of 84 lbs...

$\bar{x}$

SD

a. what is the cutoff value for the lowest 20% of the weights?



$z = \text{invnorm}(.20) = -.842$

$z = \frac{\text{value} - \text{mean}}{SD}$

$\frac{-.842}{1} = \frac{x - 1152}{84}$

$-70.7 = x - 1152$

$x = 1081$ lbs

b. what weight represents the 99th percentile?

$z = \text{invnorm}(.99) = 2.32$

Example 4: Based on a Normal distribution model of IQs with mean 100 and standard deviation of 16....

a. what cutoff value will be the highest 5% of all IQs?

b. what IQ represents the 15^{th} percentile?

Homework - Worksheet 5-6