Normal Distribution

(a) Histogram

The normal distribution is a histogram of category frequencies or proportions. Here are some examples:

(b) Central Tendency

The Normal Distribution

$\bar{x}$ Mean = Median = Mode

Probability

Values

-1.98σ   95% of values   1.98σ

-2.58σ   99% of values   2.58σ

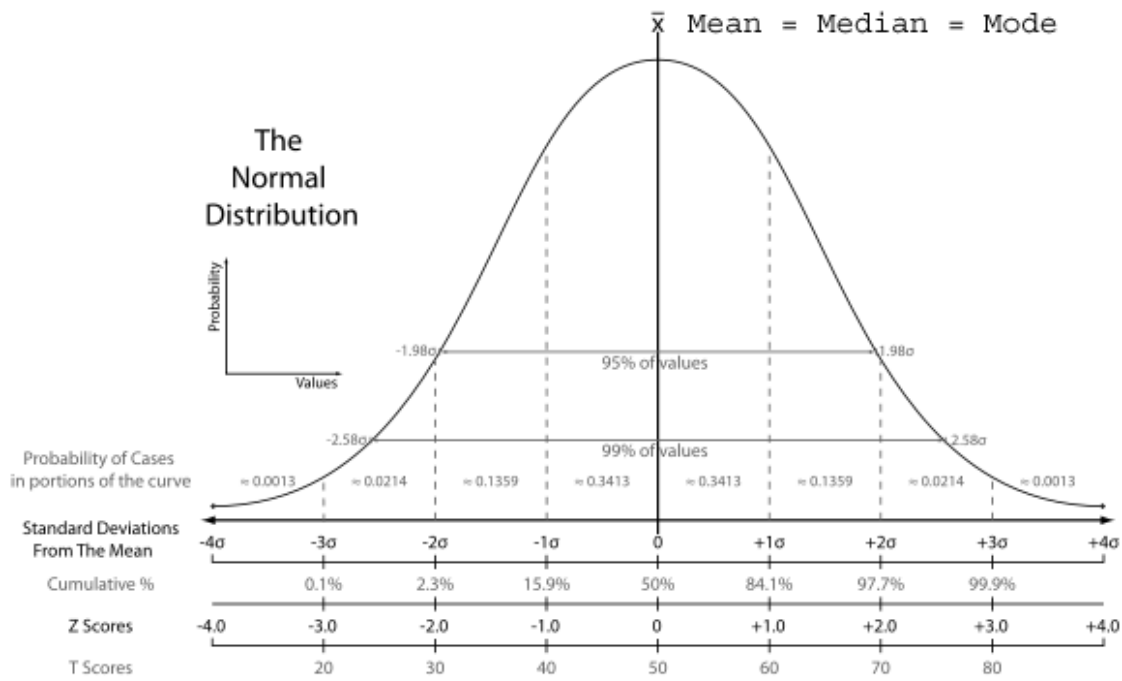| Probability of Cases in portions of the curve	≈ 0.0013	≈ 0.0214	≈ 0.1359	≈ 0.3413	≈ 0.3413	≈ 0.1359	≈ 0.0214	≈ 0.0013
Standard Deviations From The Mean	-4σ	-3σ	-2σ	-1σ	0	+1σ	+2σ	+3σ	+4σ
Cumulative %		0.1%	2.3%	15.9%	50%	84.1%	97.7%	99.9%	
Z Scores	-4.0	-3.0	-2.0	-1.0	0	+1.0	+2.0	+3.0	+4.0
T Scores		20	30	40	50	60	70	80	
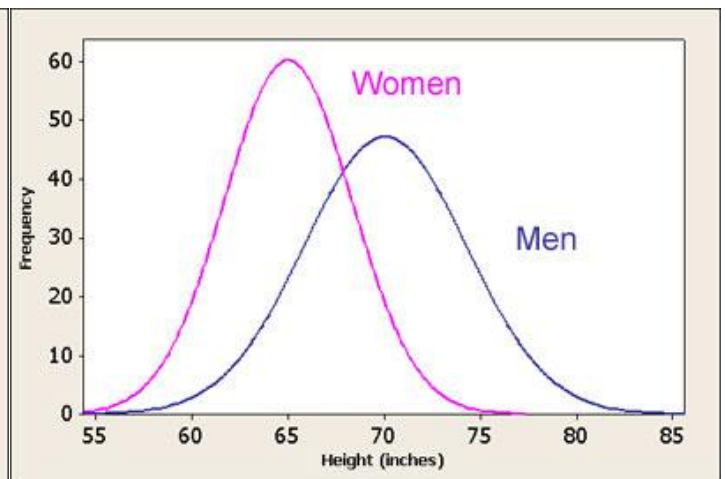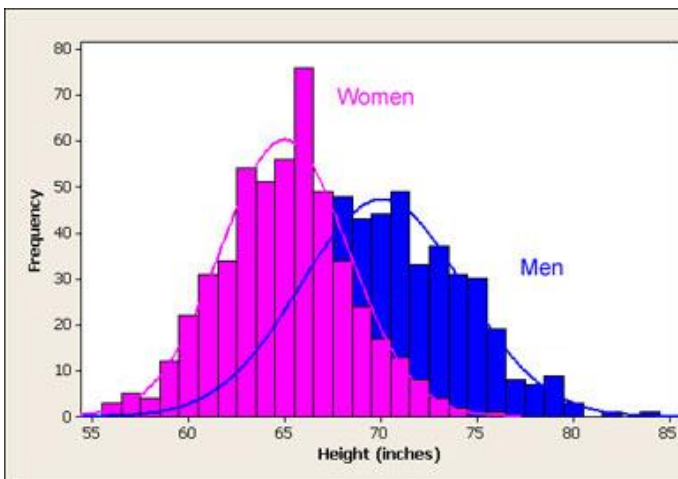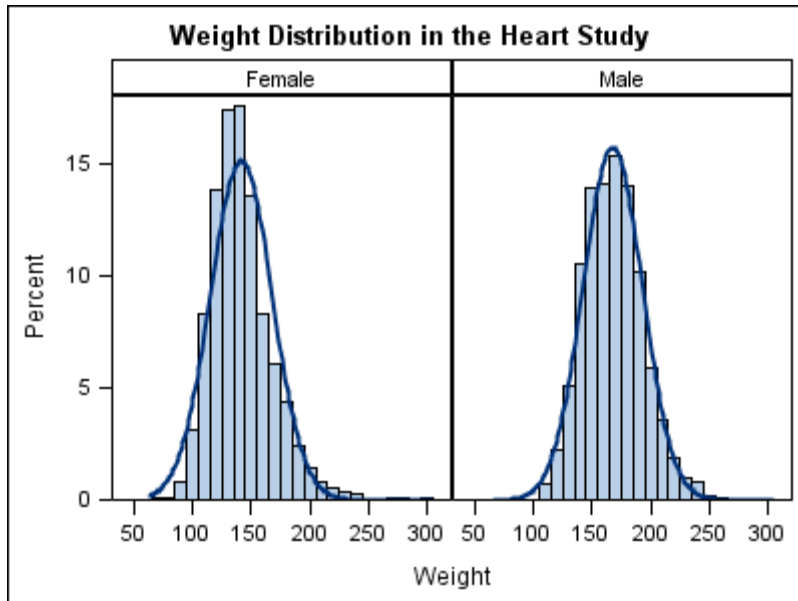
Percentile Ranks

Percentile rank (PR) – the proportion of scores at or below a given score in a distribution of scores.

Examples:
    PR = 33: A score with a PR of 33 is equal to or higher than 33% of scores in the distribution.

    PR = 76: Score with a PR of 76 equal or exceeds 76% of all scores in the distribution of scores.

Two ways to determine are reviewed (others exist, but not covered here)

(a) Frequency distribution
    For data that do not form a normal distribution (e.g., most samples, data from non-normal distributions) one may view the cumulative relative frequency to determine PR.

Example: Test scores in EDUR 8131 from Spring 2012

        63 99 95 98 94 81 61 98 88 99 75 72 86 96 95

Test_1_Scores

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	61.00	1	5.6	6.7	6.7
	63.00	1	5.6	6.7	13.3
	72.00	1	5.6	6.7	20.0
	75.00	1	5.6	6.7	26.7
	81.00	1	5.6	6.7	33.3
	86.00	1	5.6	6.7	40.0
	88.00	1	5.6	6.7	46.7
	94.00	1	5.6	6.7	53.3
	95.00	2	11.1	13.3	66.7
	96.00	1	5.6	6.7	73.3
	98.00	2	11.1	13.3	86.7
	99.00	2	11.1	13.3	100.0
	Total	15	83.3	100.0	
Missing	System	3	16.7		
Total		18	100.0		

(b) Standard Normal Distribution

       For data that form a normal distribution, one may find PR by calculating the proportion of scores below a given Z score. Once the proportion is obtained, multiply that value by 100 to obtain the PR.

GRE Math. Scores (M = 500, SD = 100)

What is the percentile rank for the following GRE Math. scores?

       GRE Math = 500

              $Z = 0$

              $p = .5$

              $PR = 50$

       GRE Math = 432

              $Z = -.68$

              $p = .2483$

              $PR = 24.83$
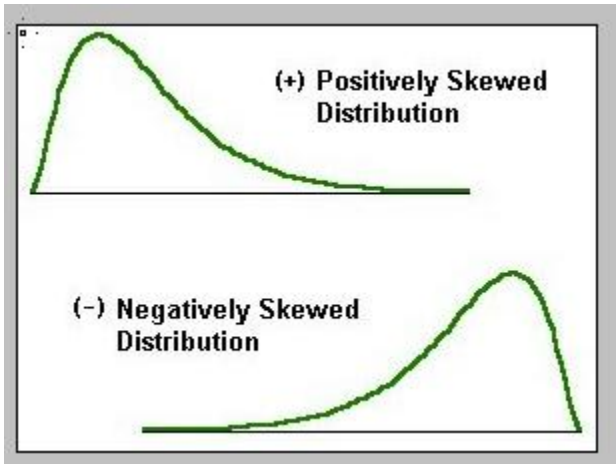
       GRE Math = 641

              $Z = 1.41$

              $p = .9207$

              $PR = 92.07$

Skew, Kurtosis, and Common Areas Under Standard Normal

Skew tends to move the mean toward the skew, and also sometimes moves the median toward the skew.