Lecture # 11

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Quality Engineering (MEEM 4650 / 5650)
Dept. of Mechanical Engineering - Engineering Mechanics
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Last Class -- Some Data

44, 62, 39, 53, 80, 33, 57, 22, 49, 68

What distribution describes this data?

Are the data normally distributed??

Cumulative Histogram (Plot)

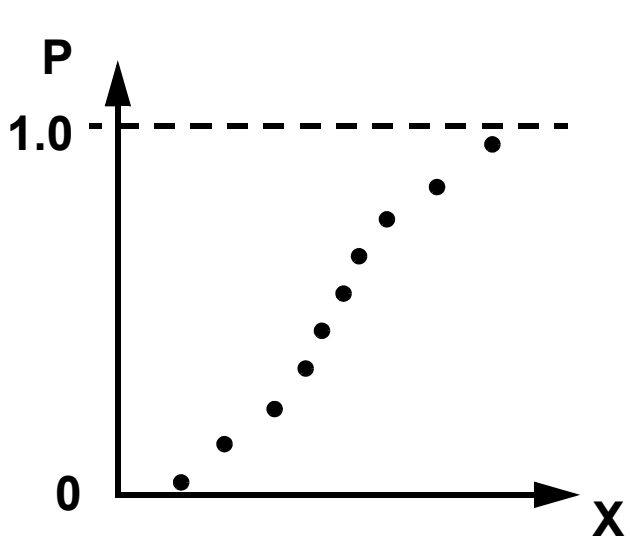
Rank X's in Ascending Order

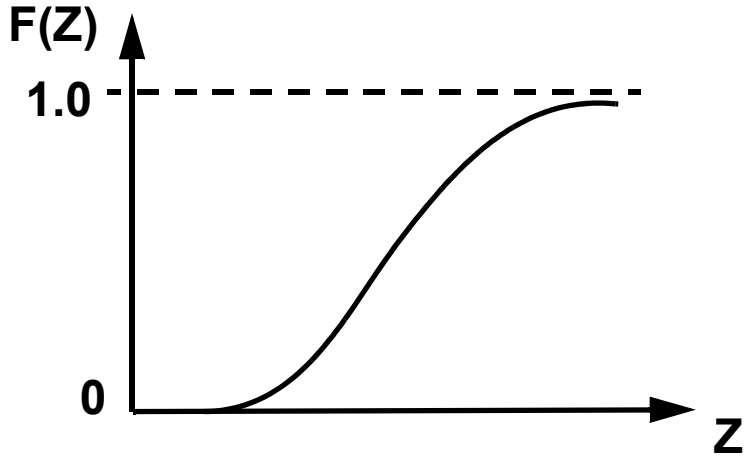
i	1	2	3	4	5	6	7	8	9	10
Ranked X's	22	33	39	44	49	53	57	62	68	80
Cum. Prob., P_i	.05	.15	.25	.35	.45	.55	.65	.75	.85	.95

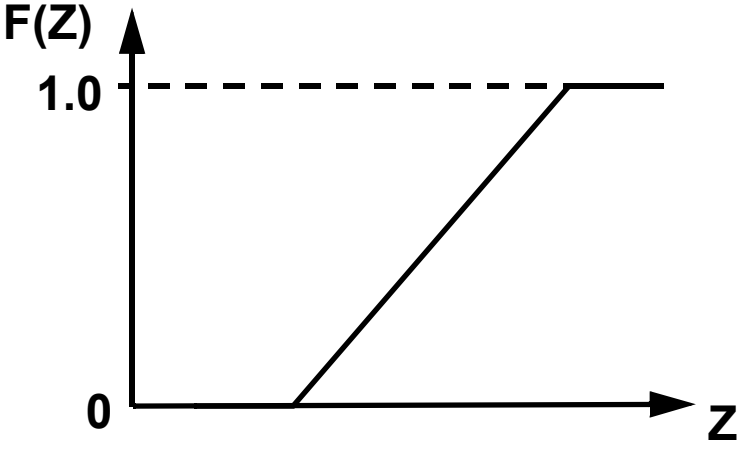
Smallest X must represent lowest 10% of underlying distribution

$P_i = (i-.5)/n$

Cumulative Histogram

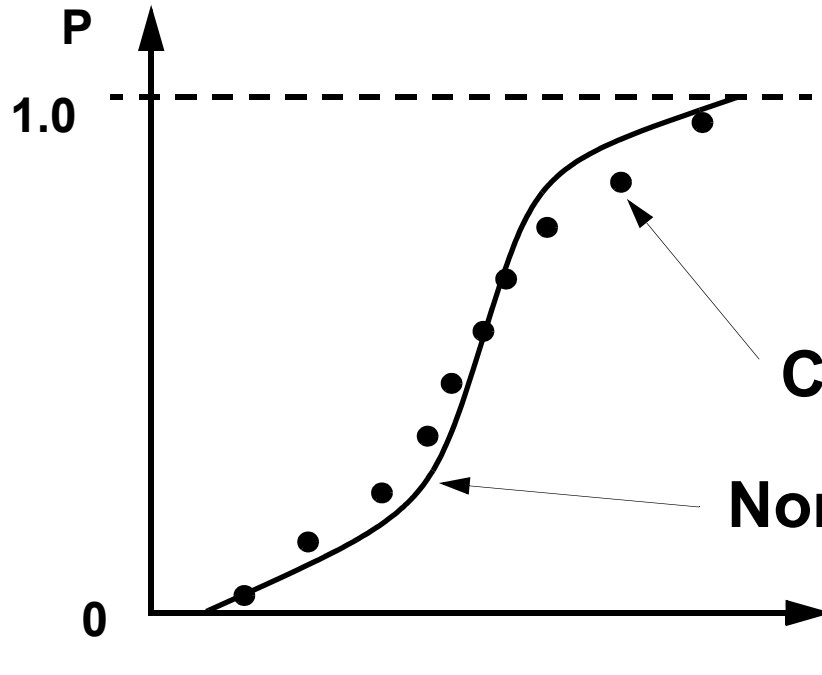






Which "S" shaped cdf best matches the cumulative probability plot of the data?

Normal Probability Paper



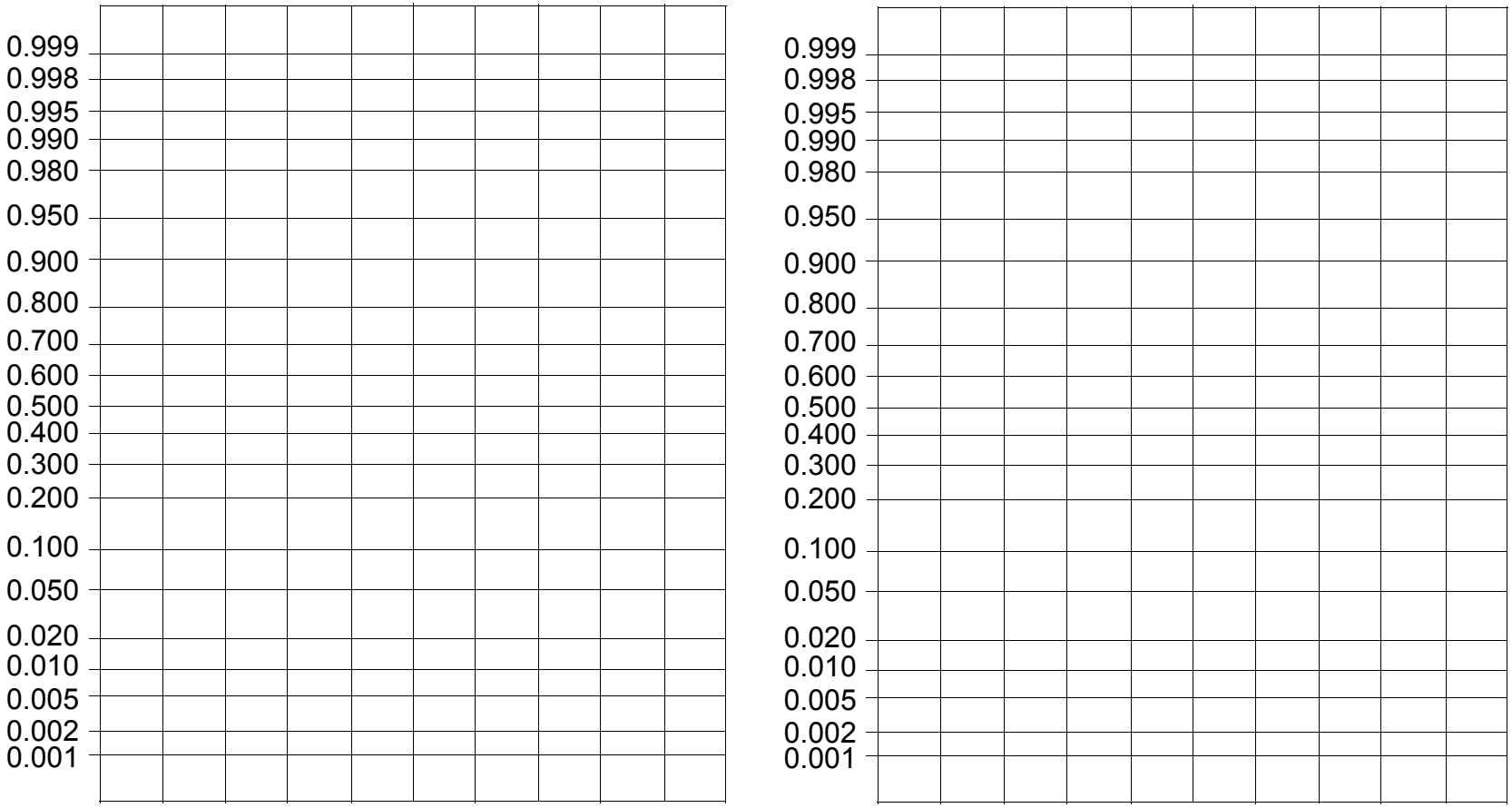
Hard to make the comparison since comparing S shapes

Cumulative Prob. Plot of Data

Normal cdf

Let's create a special vertical scale for the graph so that the Normal cdf appears as a straight line.

Normal Probability Paper



10, 23, 3, 27, 10,
29, 13, 28, 21, 4,
25, 7, 17, 30, 5

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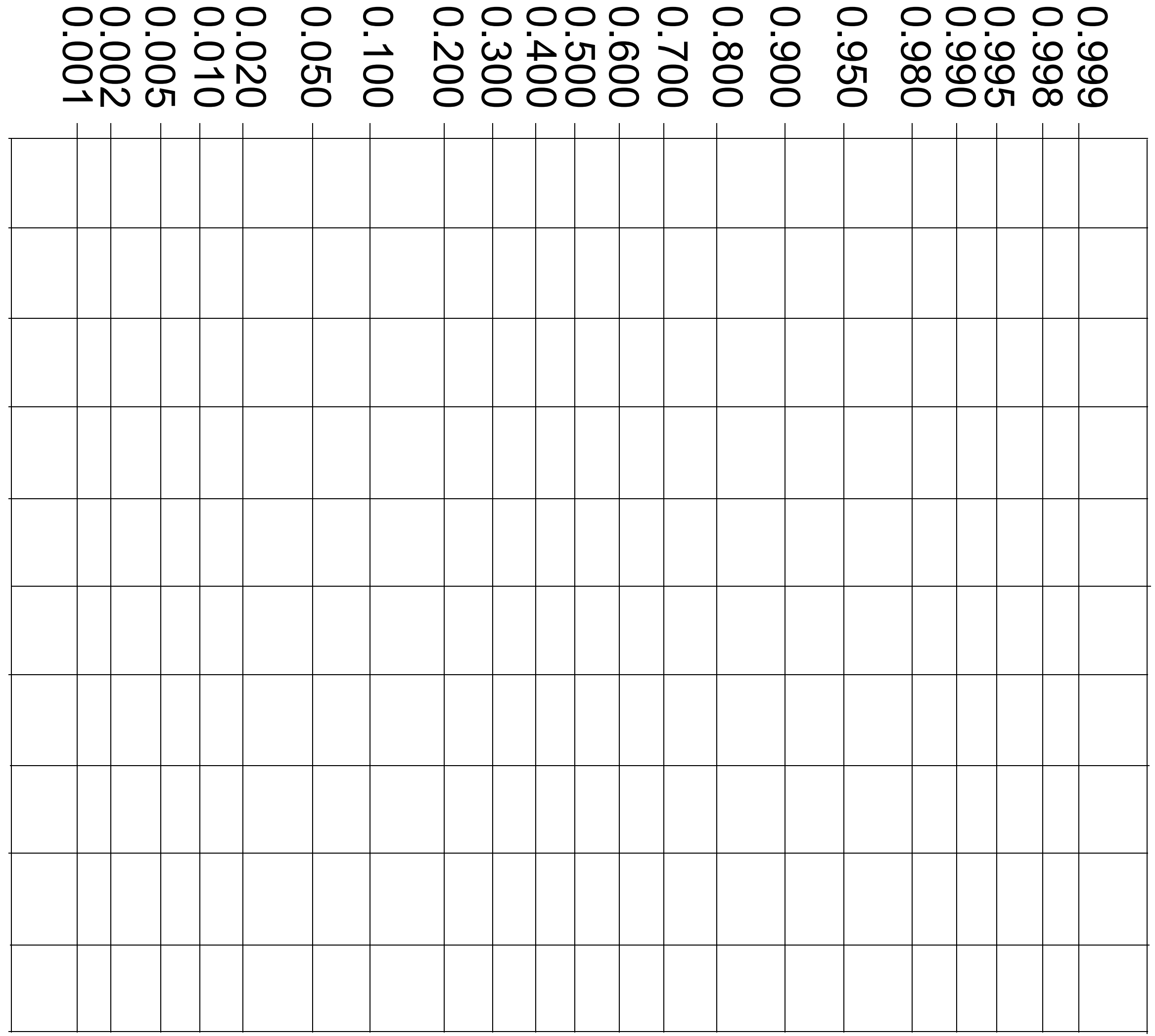
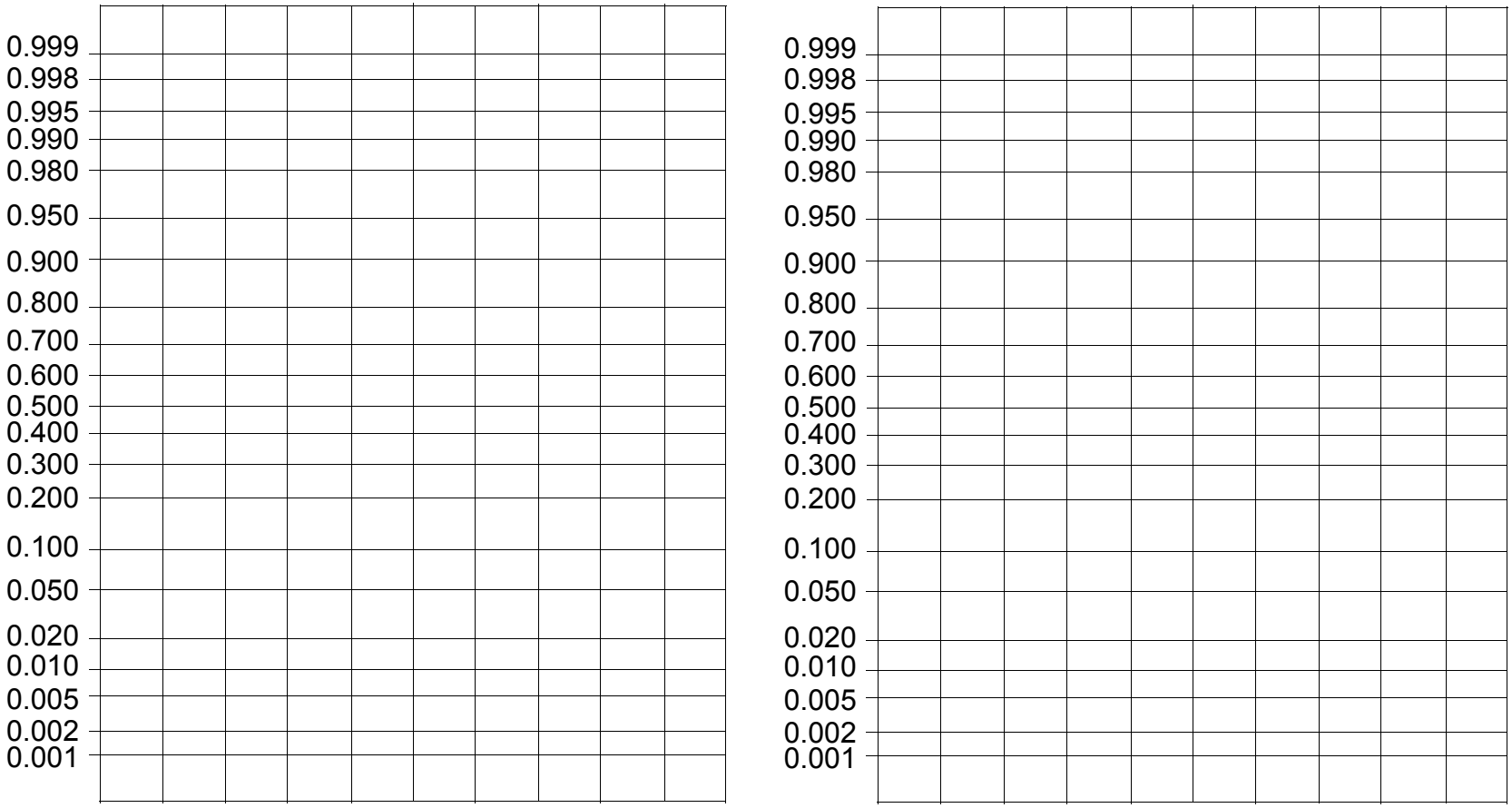
25, 16, 39, 21, 12, 28, 19, 23



Normal Probability Paper



Hypothesis Testing

1. State Null and Alternative Hypotheses (H_0 and H_A). Define test statistic.
2. Define, α, the risk level.
3. Collect Data - calculate test statistic.
4. Define reference distribution.
5. Make statistical decision
6. Draw conclusion.

Example #1

MUB claims soup is served at 160 deg. on the average. Soup temps. are know to be normal with a std. dev. of 10.

We want to test this claim!!

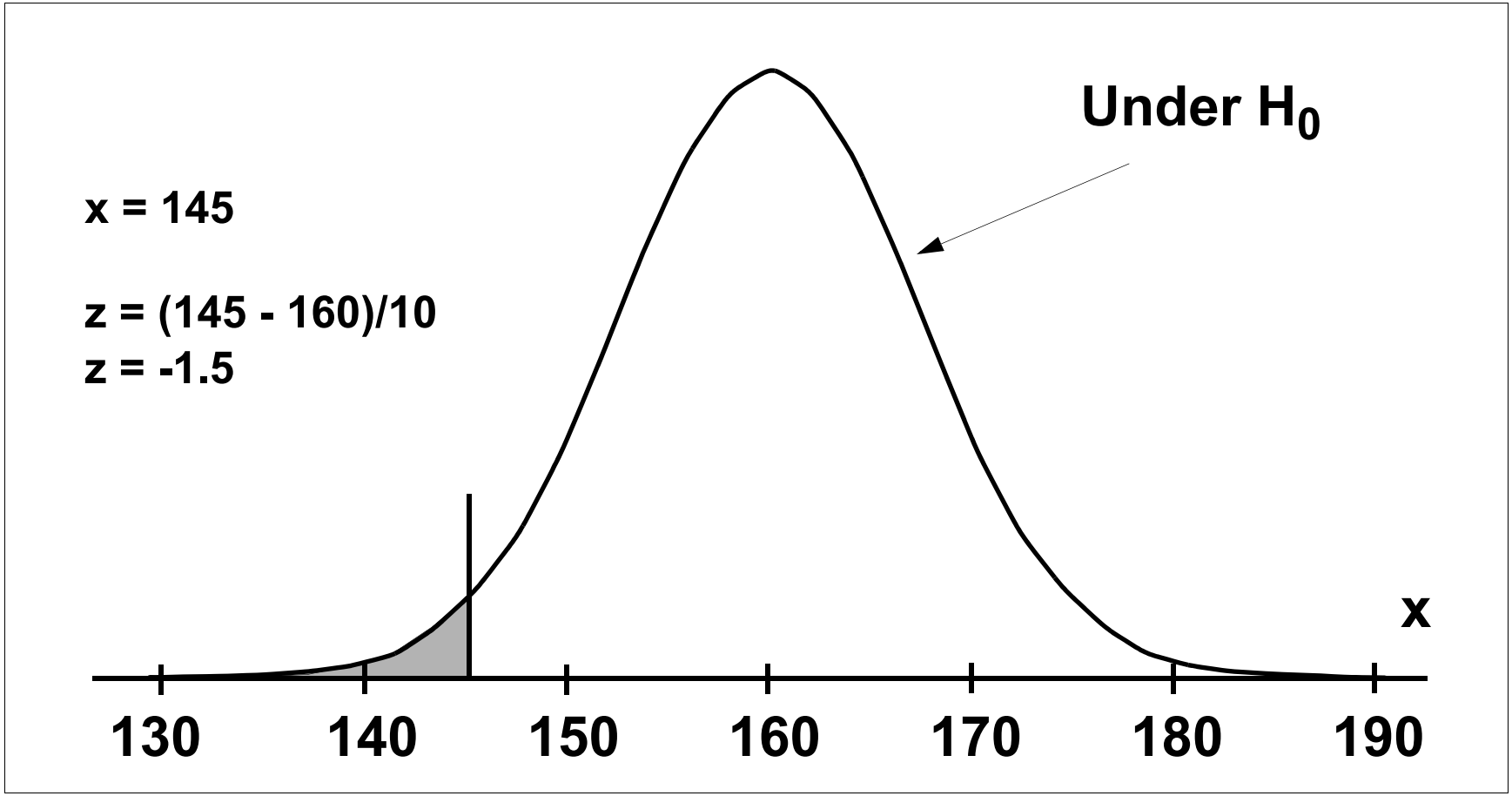
1. $H_0: \mu_x = 160$ $\quad$ $H_A: \mu_x \neq 160$

   Select a single bowl at random

2. α **= 0.05**

3. **x = 145 deg.**

4. Draw the reference distribution under the null hypothesis.



5.

$$\Pr(X \leq 145) = \Pr(Z \leq -1.5) = 0.0668$$

Compare 0.0668 with $\alpha/2 = 0.025$. Since the value obtained is not a rare event. Cannot reject H_0. This means that H_0 could be true.

6. The MUB's claim cannot be refuted. It may be true.

Example #2

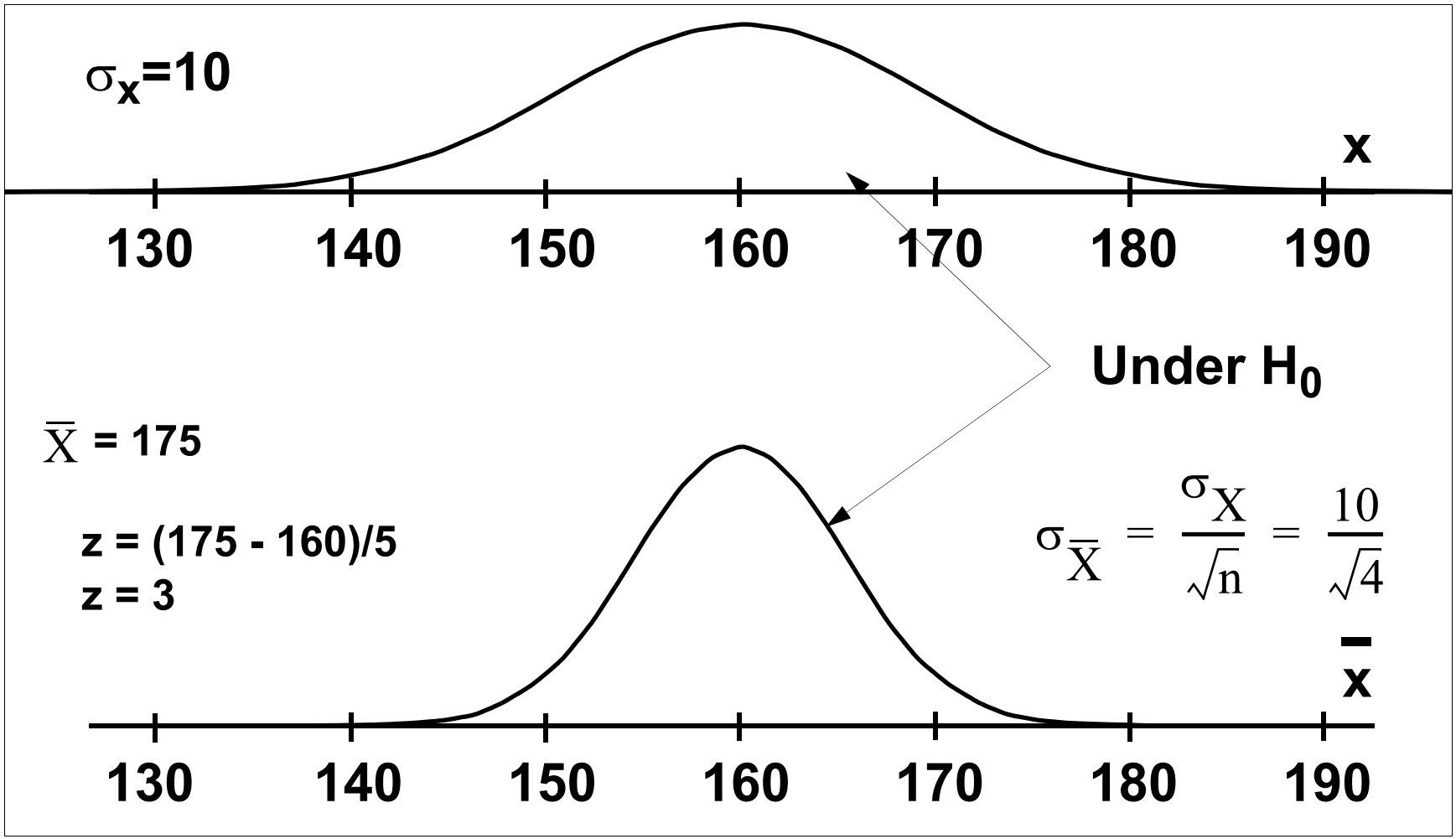
MUB claims soup is served at 160 deg. on the average. Soup temps. are known to be normal with a std. dev. of 10. X's follow normal distribution.

We want to test this claim!!

1. $H_0: \mu_x = 160$ $\qquad$ $H_A: \mu_x \neq 160$
   Select 4 bowls at random -- to form a sample

2. α **= 0.05**

3. **Pick 4 bowls (X's)** $\qquad$ $\bar{X}$ **= 175 deg.**
4. **Draw reference distribution under null hypothesis.**


σ_x=10
x
130
140
150
160
170
180
190
Under H_0
$\bar{X}$ = 175
z = (175 - 160)/5
z = 3
$\sigma_{\bar{X}} = \frac{\sigma_X}{\sqrt{n}} = \frac{10}{\sqrt{4}}$
$\bar{x}$
130
140
150
160
170
180
190

5.

$$\Pr(X \geq 175) = \Pr(Z \geq 3) = 1 - 0.99865 = 0.00135$$

Compare 0.00135 with $\alpha/2 = 0.025$. Since the value obtained is a rare event. Reject H_0.

6. The MUB's claim appears to be false.