PSY 2317 Transparency Copies
Chapter 3

Z Scores
Normal Curve
Sample and Population
Probability
DISTRIBUTION 1 from Chapter 2

M = 4  SD = 1.41
Z SCORES

A Z score places a score in a distribution.

The Z score tells how many standard deviations a raw score is away from (above or below) the mean.

\[
Z = \frac{X - M}{SD}
\]

<table>
<thead>
<tr>
<th>Distribution 1</th>
<th>M = 4</th>
<th>SD = 1.41</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>X - M</td>
<td>(\frac{X - M}{SD})</td>
</tr>
<tr>
<td>-----</td>
<td>-------</td>
<td>----------------</td>
</tr>
<tr>
<td>1</td>
<td>-3</td>
<td>-3 / 1.41</td>
</tr>
<tr>
<td>3</td>
<td>-1</td>
<td>-1 / 1.41</td>
</tr>
<tr>
<td>3</td>
<td>-1</td>
<td>-1 / 1.41</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0 / 1.41</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0 / 1.41</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1 / 1.41</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1 / 1.41</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1 / 1.41</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>2 / 1.41</td>
</tr>
</tbody>
</table>

Sum of Z scores is 0 always
DISTRIBUTION 2 from Chapter 2

M = 5   SD = 3.74
**Z SCORES**

A Z score places a score in a distribution.

The Z score tells how many standard deviations a raw score is away from (above or below) the mean.

\[ Z = \frac{X - M}{SD} \]

**Distribution 2**  
\[ M = 5 \quad SD = 3.74 \]

<table>
<thead>
<tr>
<th>X</th>
<th>X - M</th>
<th>( \frac{X - M}{SD} )</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-4</td>
<td>-4 / 3.74</td>
<td>-1.07</td>
</tr>
<tr>
<td>3</td>
<td>-2</td>
<td>-2 / 3.74</td>
<td>-.53</td>
</tr>
<tr>
<td>3</td>
<td>-2</td>
<td>-2 / 3.74</td>
<td>-.53</td>
</tr>
<tr>
<td>4</td>
<td>-1</td>
<td>-1 / 3.74</td>
<td>-.27</td>
</tr>
<tr>
<td>4</td>
<td>-1</td>
<td>-1 / 3.74</td>
<td>-.27</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0 / 3.74</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0 / 3.74</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0 / 3.74</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>10</td>
<td>10 / 3.74</td>
<td>2.67</td>
</tr>
</tbody>
</table>

Sum of Z scores is 0 always
Z SCORES

- \( M_Z = 0 \) \( SD_Z = 1 \) (called standard scores)
- To convert a raw score to a \( Z \) score
  \[
  Z = \frac{X - M}{SD}
  \]
- To convert a \( Z \) score to a raw score
  \[
  Z = \frac{X - M}{SD}
  \]
  solve for \( X \)
  \[
  Z \times SD = \frac{X - M}{SD} \times SD
  \]
  \[
  Z \times SD = X - M
  \]
  \[
  Z \times SD + M = X
  \]

Distribution 1  \( M = 4 \)  \( SD = 1.41 \)

\[
Z = .5 \quad X = ?
\]

\[
X = .5 \times 1.41 + 4 = .71 + 4 = 4.71
\]

Distribution 2  \( M = 5 \)  \( SD = 3.74 \)

\[
Z = .5 \quad X = ?
\]

\[
X = .5 \times 3.74 + 5 = 1.87 + 5 = 6.87
\]
NORMAL CURVE (GAUSSIAN DISTRIBUTION)

SYMMETRIC
UNIMODAL
MEAN = MEDIAN = MODE
NORMAL CURVE (GAUSSIAN DISTRIBUTION)
NORMAL CURVE (GAUSSIAN DISTRIBUTION)

\[ Z = 0 \]

50% 50%
NORMAL CURVE (GAUSSIAN DISTRIBUTION)

Scores

Z Scores

-2  -1  0  +1  +2

2%  14%  34%  34%  14%  2%
% of area under the curve between the mean and $Z = 1$

% of Area under the curve between the mean and $Z = 2$

% of area under the curve between the mean and $Z = -1$
% of Area under the curve
Below $Z = -1.2$

% of Area under the curve
between $Z = .5$
and $Z = 1.5$

% of Area under the curve
Below $Z = 1.5$
% of Area under the curve
between $Z = -0.2$
and $Z = 0.6$

Given a % of area -- find $Z$

Susie scored at the 70th percentile
What was her $Z$ score?

Susie scored at the 30th percentile
What was her $Z$ score?
Given a \( \% \) of area -- find \( Z \)

If 10\% got better scores than Susie
What is her percentile?
What is her \( Z \) score?
% of scores (area)

Below \( Z = 1.3 \)

% of scores (area)

Above \( Z = .4 \)

% of scores (area)

Between \( Z = -.7 \) and \( Z = -.2 \)
A score is at the 40th percentile
  the Z score is?

If 15% got a higher score
  What is the Z score?

What Z scores delimit the central 70% of area under the normal curve?
## POPULATION vs SAMPLE

### POPULATION

All those of interest for your research

### SAMPLE

Those selected from the population to study

Should be representative of the population

Random selection is best - but 
often not practical

<table>
<thead>
<tr>
<th>SAMPLE STATISTICS</th>
<th>POPULATION PARAMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEAN</td>
<td>M</td>
</tr>
<tr>
<td>VARIANCE</td>
<td>( SD^2 )</td>
</tr>
<tr>
<td>STD DEV</td>
<td>( SD )</td>
</tr>
</tbody>
</table>
PROBABILITY

EXPECTED RELATIVE FREQUENCY

A RATIO

\[ p = \frac{\# \text{ successful outcomes}}{\# \text{ possible outcomes}} \]

Coin toss

\[ p \text{ (falls on heads)} = \frac{1}{2} = .5 \]

Throw a die

\[ p \text{ (comes up 5)} = \]

\[ p \text{ (comes up even)} = \]

\[ p \text{ (comes up 7)} = \]

\[ p \text{ (comes up 1, 2, 3, 4, 5 or 6)} = \]

\( p \) ranges from 0 to 1
**ADDITION RULE**

When 2 events are MUTUALLY EXCLUSIVE

(They can’t happen at the same time)

Example - Getting a 3 or 5 when tossing a die

\[ p(3 \text{ or } 5) = \]

---

**MULTIPLICATION (PRODUCT) RULE**

When 2 events are INDEPENDENT

(One doesn’t influence the other )

Example - Tossing a coin twice

\[ p(\text{2 heads}) = \]
NORMAL CURVE (GAUSSIAN DISTRIBUTION)

\[ Z \leq -1 \] 14%  34%  34%  14%  2%

\[ Z \geq 2 \] 2%  2%

\[ p (Z \leq -1) = 16\% = .16 \]

\[ p (Z \geq 2) = 2\% = .02 \]