

## WORKSHEET: NORMAL DISTRIBUTION PRACTICE

**Part I.** For each of the following, (1) draw a picture of a bell curve and shade in a relevant region under the curve, and then (2) use the R functions `pnorm` and/or `qnorm` (or equivalent) to calculate the stated quantity.

- (a) The percentage of observations whose  $z$ -scores are less than 1.5.
- (b) The percentage of observations whose  $z$ -scores are greater than 1.5.
- (c) The percentage of observations whose  $z$ -scores are between  $-0.5$  and  $2$ .
- (d) The percentage of observations whose  $z$ -scores have absolute value greater than  $1.25$ .
- (e) The  $z$ -score that is larger than exactly 90% of observations.
- (f) The  $z$ -score that is less than exactly 75% of observations.
- (g) The number  $z^*$  such that 80% of the observations are contained within  $z^*$  standard deviations of the mean.
- (h) The number  $z^*$  such that 90% of the observations are contained within  $z^*$  standard deviations of the mean.

**Part II.** In triathlons, it is common for racers to be placed into age and gender groups. Leo and Mary are friends who completed the Hermosa Beach Triathlon, where Leo competed in the “Men, Ages 30–34” group while Mary competed in the “Women, Ages 25–29” group. Leo completed the race in 1:22:28 (4948 seconds), while Mary completed the race in 1:31:53 (5513 seconds). Obviously, Leo finished faster, but they are curious about how they did within their respective groups. Can you help them? Here is some information on the performance of their groups:

- The finishing times of the “Men, Ages 30–34” group has a mean of 4313 seconds with a standard deviation of 583 seconds.
  - The finishing times of the “Women, Ages 25–29” group has a mean of 5261 seconds with a standard deviation of 807 seconds.
  - The distributions of finishing times for both groups are approximately normal.
- (a) What are the  $z$ -scores for Leo’s and Mary’s finishing times? What do these  $z$ -scores tell you?
  - (b) Did Leo or Mary rank better in their respective groups? Explain your reasoning.
  - (c) What percent of the triathletes did Leo finish faster than in his group?
  - (d) What percent of the triathletes did Mary finish faster than in her group?
  - (e) If the distributions of finishing times are not nearly normal, would your answers above change? Explain your reasoning.
  - (f) What is the cutoff time for the fastest 5% of athletes in the men’s group?
  - (g) What is the the cutoff time for the slowest 10% of athletes in the women’s group?