INTRODUCTION TO BIOSTATISTICS

How to read the standard normal table

(Table A.3 of Principles of Biostatistics, Pagano, M. and Gauvreau, K.)

When reading a normal table, we take advantage of the following features of the normal distribution:

- The **symmetry** of the standard normal curve around zero (its mean). Thus, $P(Z \geq z) = P(Z \leq -z)$, where $z \geq 0$.
- The fact that (as in any distribution) the area under the curve is equal to 1. Thus, $\{Z \geq z\}$ and $\{Z \geq z\}$ are two complementary events, $P(Z \geq z) = 1 - P(Z \leq z)$.

We are usually faced with two problems:

1. Given a number $z \geq 0$[1] (say) find p such that the following is true:

   1.1. $P(Z \geq z) = p$ — Read p directly from standard normal table[2].

   1.2 $P(Z \leq -z) = p$ — Read $p_1 = P(Z \geq z)$ from the normal table
   $p = p_1$ (by the symmetry of the normal distribution)

   1.3 $P(Z \leq z) = p$ — Read $p_1 = P(Z \geq z)$ from the normal table: $p = 1 - p_1$.
   Notice that $\{Z \geq z\}$ and $\{Z \leq z\}$ are complementary events

   1.4 $P(Z \geq -z) = p$ — Read $p_1 = P(Z \geq z)$ from the normal table: $p = 1 - p_1$.

   Now assume that $z_1 \leq z_2$:

   1.5 $P(z_1 \leq Z \leq z_2) = p$ — Calculate $p_1 = P(Z \geq z_1)$ (if $z_1 \geq 0$ refer to 1.1, if $z_1 < 0$ refer to 1.4) and $p_2 = P(Z \geq z_2)$ (if $z_2 \geq 0$ refer to 1.1, if $z_2 < 0$ refer to 1.4); then $p = p1 - p2$

   Special case: $z > 0$
   $P(-z \leq Z \leq z)$ — Read $p_1 = P(Z \geq z)$ from the normal table $p = 1 - 2p_1$.
   Notice that this is the **central** part of the distribution.

2. Given a probability p find z such that the following is true:

   2.1 $P(Z \geq z) = p$

   If $p \leq 0.5$ — Then $z \geq 0$: Look up p in table. z is the closest number[3].

   If $p \geq 0.5$ — Then $z \leq 0$: Look up $p_1 = 1 - p$ in the table. Locate the closest number. z is its negative.

   2.2 $P(Z \leq z) = p$

   If $p \leq 0.5$ — Then $z \leq 0$: Look up p in table. Locate the closest number. z is its negative.

   If $p \geq 0.5$ — Then $z \geq 0$: Look up $p_1 = 1 - p$ in the table. z is the closest number.

   2.3 $P(-z \leq Z \leq z) = p$ — Look up $p_1 = (1 - p)/2$ in the table. z is the closest number. $-z$ is its negative.

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[1] Recall that capital Z is the (normally distributed) random variable, while z is the values it assumes

[2] The p corresponding to z is read by going "down" in the table as many lines as it's necessary to approach z as closely as possible (without going over), and then going "across" on the same line, as many columns as it's necessary to approach z as closely as possible (without going over).

[3] The "closest number" z corresponding to a given p is found by adding the number in the left margin of the *line* where p is located in the table, to the number at the top margin of the *column* where p is located in the table.