

## Exercise 1

Imagine you conducted an experiment in which you flash stimuli on a computer screen for just a few milliseconds and at low contrast, so that they are really hard to see. On every trial, the stimulus is either a square or a diamond, with random order and equal probability across trials. After every presentation you ask your subject whether the square or the diamond was presented. Can you use SDT to analyze your data? Motivate your answer.

**Answer:**

Yes. You can treat one or the other as signal and the other as noise without losing any information. A liberal response tendency (negative  $c$ ) would then not indicate a tendency towards 'yes' responding, but towards reporting the stimulus you defined as being the signal.

## Exercise 2

Imagine you conducted an experiment in which you flash stimuli on a computer screen for just a few milliseconds and at low contrast, so that they are really hard to see. On every trial, the stimulus is either a square or a diamond, with random order and equal probability across trials. After every presentation you ask your subject whether she consciously perceived the stimulus that was presented. Can you use SDT to analyze your data? Motivate your answer.

**Answer:**

No. Although you have a yes/no situation, you cannot use SDT because the subject has no possibility to make false alarms or correct rejections since the signal is always present. What you should have done is include 'catch' trials (trials where no stimulus is presented) so you can get an idea of the subject's bias ( $c$ ). Now the best you can do is use percentage correct and you cannot know what influence the subject's response tendency had.

## Exercise 3

You run two races. In one race your time was 1.5 hours, the population mean was  $\mu = 2.25$  hours and the population standard deviation was  $\sigma = 0.25$ . In the second race, your time was 1.75 hours, the population mean was  $\mu = 2.5$  hours and the population standard deviation was  $\sigma = 0.2$ . In which race did you do better relative to everyone else? (I.e., in which race did you have the lower z-score?)

**Answer:**

$$Z_1 = (1.5 - 2.25) / 0.25 = -3$$

$$Z_2 = (1.75 - 2.5) / 0.2 = -3.75$$

Therefore, performance was better in the second race.

## Exercise 4

You are comparing two diets, the Paleo diet and the Atkins diet. You take two samples of 10 people each and measure the amount of weight each person loses on their respective diets. The results are given in the table to the right. Calculate an independent samples t-test and state whether or not there is a difference between the amount of weight lost under the two diets.

Paleo (kg)	Atkins (kg)
5.16	4.6
5.21	5.12
5	5.06
5.5	5.64
4.69	4.66
4.86	4.71
4.88	4.65
5.05	4.66
5.01	4.83
4.73	4.55

**Answer:**

Step 1: State the hypothesis and select an alpha level.

$H_0: \mu_1 - \mu_2 = 0$  (For the population, there is no difference between treatment A and treatment B)

$H_1: \mu_1 - \mu_2 \neq 0$  (For the population, there is a difference between treatment A and treatment B)

We will set the level of significance to  $\alpha = 0.05$ , 2-tailed.

Step 2: identify the critical region.

For the independent-measures t statistic, degrees of freedom are determined by

$$df = n_1 + n_2 - 2 = 10 + 10 - 2 = 18$$

The t distribution table is consulted, for a 2-tailed test with  $\alpha = 0.05$  and  $df = 18$ . The critical t values are  $-2.1009$  and  $+2.1009$ .

Step 3: compute the test statistic.

Paleo diet:

$$N_1 = 10$$

$$M_1 = (5.16 + 5.21 + 5 + 5.5 + 4.69 + 4.86 + 4.88 + 5.05 + 5.01 + 4.73) / 10 = 5.009$$

$$\text{Var1} = 0.0583$$

$$\text{df1} = 10 - 1 = 9$$

Atkins diet:

$$N2 = 10$$

$$M2 = (4.6 + 5.12 + 5.06 + 5.64 + 4.66 + 4.71 + 4.65 + 4.66 + 4.83 + 4.55) / 10 = 4.848$$

$$\text{Var2} = 0.1140$$

$$\text{Pooled variance } S^2_{\text{pool}} = \frac{\text{df1} \times \text{Var1} + \text{df2} \times \text{Var2}}{\text{df1} + \text{df2}} = \frac{9 \times 0.0583 + 9 \times 0.1140}{18} = 0.0862$$

$$\text{Pooled standard deviation } S_{x_1 - x_2} = \sqrt{\frac{S^2_{\text{pool}}}{N1} + \frac{S^2_{\text{pool}}}{N2}} = 0.1313$$

$$\text{Compute t value } t = \frac{M1 - M2}{S_{x_1 - x_2}} = \frac{0.1601}{0.1313} = 1.2262 < 2.1009$$

So  $H_0$  is not rejected, there is no significant difference between two diet.