Exercises in sensR basics

Per Bruun Brockhoff

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Topics:

- Three levels of analysis (d', p_d and p_c). Exercises {1, 2, 3, 4, 5}.
- Analysis of data from sensory discrimination experiments using the simple-binomial protocols using hypothesis/significance tests, p-values and confidence intervals. Exercises {1, 5}.
- Power and sample size computations for sensory discrimination tests using the simple-binomial protocols. Exercises {6, 7}.

Exercise 1

You have conducted a Duo-Trio experiment, and it yielded 21 correct answers out of 30 tests.

1. Have you proven that the products differ?
2. What range of values for d' and p_d are plausible given the data you have?

Exercise 2

If you have a d' of 1.0 with a 3-AFC test, what is p_d and p_c (hint: use the `rescale`-function in sensR)?

Exercise 3

You have conducted a Triangle test (test 1) with 73% correct answers. Your colleague tested the same products with the same test (test 2) and she found that 37% of the participants could detect the difference between the products.

1. Calculate p_c, p_d and d' for both tests using the `rescale`-function in sensR
2. Which of the two tests indicate the largest product difference?

Exercise 4

You are reading about a sensory difference test of two products A and B in a report from another group in your company. They obtained 70% correct answers in a 2-AFC test and concluded that there was a large difference between the products.

1. Do you agree with their finding? (Hint: compute d' using `rescale` and interpret how big it is)
2. Later in the report you read about another difference test between product A and a new product C. Here the group used a Duo-Trio test and obtained only 60% correct answers. Consequently the group concludes that the sensory difference between A and C is considerably smaller than between A and B. Do you agree with their conclusion?

Exercise 5

A company has contacted you and offers to provide an ingredient you need for your products but at a lower price than your current supplier. You are worried, however, that using the new supplier will result in important changes to your product, so you decide to test if there is a difference with the Triangle test before adopting the new supplier.

1. Write up the null and alternative hypotheses: Express them in words and subsequently express them in terms of the proportion of correct answers, the proportion of discriminators and in terms of d'.
2. You planned and conducted the experiment and obtained 82 correct answers out of 200 consumer evaluations in a Triangle test. What is the probability of obtaining 82 or more correct answers out of 200 if there is no difference between the products? Does that provide evidence in favour of a difference between the products?
3. Is it plausible that the product difference is as large as $d' = 2$?
4. Is it plausible that as little as 2% of consumers can detect the difference between the products?

Exercise 6

You are asked by the management in your company to conduct a 2-AFC test with n=50 and alpha=5%. You expect the products are easily confused with a d' around 0.5 to 0.7.

1. Use the `d.primePwr` function to find out what the probability of detecting a difference around 0.5 and 0.7 is (i.e. estimate the power of this test).
2. Are 50 subjects enough to detect a difference of these magnitudes with a reasonable power (around 80%)?

3. Management informs that it is important to find out if these products really are different, so you are asked to conduct the experiment with as many subjects as you need. Management requires that you have at least 90% power in detecting the difference. Use the `d.primeSS` function to compute the number of subjects that you need (alpha = 5% and d' between 0.5 and 0.7)

4. Compute both the first-exact and stable-exact sample sizes. How many samples are enough in the most optimistic case? How many would you need in the most cautious case? How many samples do you suggest to management that you use?

Exercise 7 (difficult)

Your boss has asked you to carry out a 3-AFC test with 30 observations to determine if there is a difference between two slightly different recipes of the same product. Your company could save money by using the cheaper recipe, but you don't want to send a different product on the market.

1. What is the value of d' under the null and alternative hypotheses? Adopt a significance level of 5% and work with a scenario where the difference between the products is d' = 0.8.

2. What is the power of this test?

3. What is the probability of

   (a) Correctly claiming that the products are different?

   (b) Wrongly accepting that the products are not different?

   (c) Wrongly claiming that the products are different?

   (d) Correctly accepting that the products are not different?

4. Use the `d.primePwr` function and experiment with different values of `d.primeA` to find out which value of d' you would be able to detect with a probability of 80%.