

Stat 425 HW2

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Chapter 1, Section 4, Problem 46.:

To test the effectiveness of vitamin B₁ in stimulating growth in mushrooms, vitamin B₁ was applied to 13 mushrooms selected at random from a group of 24, while the remaining 11 did not receive this treatment. The weights of the mushrooms at the end of the period of observation were¹ (in milligrams)

Controls: 18 14.5 13.5 12.5 23 24 21 17 18.5 9.5 14
Treated: 27 34 20.5 29.5 20 28 20 26.5 22 24.5 34 35.5 19

1. Give the sorted vector of midranks for all observations.
2. What is the observed value of W_s^* ?
3. Use the normal approximation to find the significance probability of these results.
4. For the exact null distribution of W_s^* how many midrank sums need to be computed?
5. Compute the exact p -value for the observed value of W_s^* (this may take a few minutes).
6. Compute an estimated p -value based on $N_{\text{sim}} = 100,000$ simulations. (execute `set.seed(35)` just prior to running the simulation). This may take a few minutes.
7. Discuss the merits of the three p -value calculations, in terms of accuracy, computation time, and general usability.

Chapter 1, Section 4, Problem 49.:

In the context of Prob. 42, suppose that $m = n = 10$ and the data are given in the following table:

	Very Poor	Poor	Indifferent	Good	Very Good
Control	2	2	5	1	0
Treatment	0	2	4	3	1

1. Find the observed value of W_s^* .
2. Give the exact p -value for this observed value of W_s^* .
3. Find the normal approximation for this p -value.
4. Find the critical value c giving the significance level closest to .01, using the exact distribution vector developed in 2. Here it helps to look at the sorted unique values of the exact distribution vector (use `unique(...)`) and compute some of the corresponding upper tail probabilities.
5. Compare this $P(W_s^* \geq c)$ (closest to .01) with its normal approximation.
6. Use the normal approximation of the above c corresponding to .01, rounding it to the nearest multiple of .5 (Due to midranks W_s^* takes only values that are multiples of .5).

¹From Linder, *Statistische Methoden*, 2d ed., Birkhäuser, Basel, 1951, p. 91. Original data from Schopfer and Blumer, "Zur Wirkstoffphysiologie von *Trichophyton album* Sab.," *Ber. Schweiz. Botan. Ges.* **53**:409–456 (1943).