STAT3004: Basic Methods in Biomedical Statistics
Assignment 2
Due date: 12 October 2020, 5pm

The following problems are based on questions that can be found in *Fundamentals of Biostatistics, 8th Ed.* by Bernard Rosner, unless stated otherwise.

1. **Problems 9.36-9.38 in Rosner**
   Perform two hypothesis tests, one parametric and one nonparametric, to assess whether there are significant differences in mean/median BMD for the femoral neck between the heavier- and lighter-smoking twins using the data set `BONEDEN.csv`. Compare and comment on the results.

2. **Problems 9.1-9.6 in Rosner**
   In a study, 28 adults with mild periodontal disease are assessed before and 6 months after implementation of a dental-education program intended to promote better oral hygiene. After 6 months, periodontal status improved in 15 patients, declined in 8, and remained the same in 5.

   (a) Assess the impact of the program statistically (use a two-sided test).

   (b) Suppose patients are graded on the degree of changes in periodontal status on a 7-point scale, with +3 indicating the greatest improvement, 0 indicating no change, and -3 indicating the greatest decline. The data are provided in Table 1. What nonparametric test can be

Change score	Number of patients
+3	4
+2	5
+1	6
0	5
-1	4
-2	2
-3	2

Table 1: Degree of change in periodontal status

   used to determine whether a significant change in periodontal status has occurred over time? Implement it and report a p-value.

   (c) Suppose there are two samples of size 12 and 15, with a rank sum of 220 in the sample of size 12. Assuming there are no ties, use the Wilcoxon rank-sum test to evaluate the significance of the results.

3. **Problems 10.21-10.22 in Rosner**
   Many children have tympanostomy tubes surgically inserted in their ears to reduce hearing loss associated with persistent otitis media and prevent recurrence of episodes of otitis media after tubes are inserted. However,

acute otorrhea, where middle ear fluid drains through the tube, is a common side effect with tympanostomy tubes. A clinical trial was conducted (Van Dongen et al.) among children 1-10 years of age with prior symptoms of otorrhea comparing efficacy of (i) antibiotic eardrops, (ii) oral antibiotics, and (iii) observation without treatment, referred to below as observation. Children were seen at home by study physicians at 2 weeks and 6 months after randomization. The primary outcome was the presence of otorrhea at 2 weeks observed by study physicians. The results are summarized in Table 2.

Group	No. children	No. children with otorrhea at 2 weeks
Eardrops	76	4
Oral	77	34
Observation	75	41

Table 2: Otorrhea Study

(a) What test can be used to compare the prevalence of otorrhea for the ear drop group vs. the observation group? State the hypotheses to be tested.

(b) Perform the hypothesis test in (a) and report a two-tailed p-value. Interpret your results in words.

4. **Problems 10.74-10.77 in Rosner**
A study was performed to look at the preference of different species of birds for different types of sunflower seeds. Two bird feeders were set up with different types of sunflower seeds, one with a black oil seed and one with a striped seed. The bird feeders were observed for a 1-hour period for each of 12 days over a 1-month period. The number of birds of different species who ate seeds from a specific bird feeder was counted for each bird feeder for each of a number os species of birds. (The data for this problem were supplied by David Rosner.) On the first day of testing, 1 titmouse ate the black oil seeds and 4 titmice ate the striped seeds. Of the goldfinches, 19 ate the black oil seeds and 5 ate the striped seeds.

(a) What test can be performed to assess whether the feeding preferences of titmice and goldfinches are comparable on the first day of testing?

(b) Implement the test in (a), and report a p-value.

(c) One assumption in the entire experiment is that the feeding preferences of the same species of bird remain the same over time. To test this assumption, the data for goldfinches were separated by the 6 different days on which they were observed (they were not observed at all for the other 6 days). For 2 of the 6 days, small numbers of goldfinches were observed (2 on one day and 1 on another day). Thus data from these two days were also not included. The results for the

Type of seed	Day 1	Day 2	Day 3	Day 4	Total
Black oil	19	14	9	45	87
Striped	5	10	6	39	60

Table 3: Birds and Sunflower Seeds Study

remaining 4 days are shown in Table 3. What test can be used to assess whether the feeding preference of goldfinches are the same on different days?

(d) Implement the test in (c) and report a p-value.