MATH 252-01: Probability and Statistics II

Problem Set 12

Assigned 2016 November 29
Due 2016 December 6

Show your work on all problems! If you use a computer to assist with numerical computations, turn in your source code as well.

1 Devore Chapter 15, Problem 12

2 Devore Chapter 15, Problem 22

3 Devore Chapter 15, Problem 32

4 Computational Exercise

The paper "Search for gravitational-wave inspiral signals associated with short Gamma-Ray Bursts during LIGO's fifth and Virgo's first science run" (*The Astrophysical Journal* **715**, 1453 (2010), available on campus via `http://stacks.iop.org/ApJ/715/1453` and off campus via `http://stacks.iop.org.ezproxy.rit.edu/ApJ/715/1453`) reported on a search for gravitational waves in 22 time windows, each corresponding to a gamma-ray burst. None of these results was individually significant, i.e., the highest detection statistic was consistent with noise given the "trials factor" of 22. To test whether there was an overabundance of signals too weak to be individually significant, the authors also performed a Mann-Whitney U test of these 22 "on-source" results against a set of 6801 "off-source" searches at times with no GRB, and reported, "Applying the U-test, we find that the two distributions are consistent with each other; if the on-source and off-source significances were drawn from the same distribution, they would yield a U-statistic greater than what we observed 53% of the time." Download the results from
`http://ccrg.rit.edu/~whelan/courses/2016_3fa_MATH_252/data/ps12_prob4_onsource.dat`
`http://ccrg.rit.edu/~whelan/courses/2016_3fa_MATH_252/data/ps12_prob4_offsource.dat`
using the username and password given in class, and perform the Mann-Whitney U test or the equivalent Wilcoxon rank-sum test. Convert the statistic to an equivalent z score via the normal approximation using the expected mean and standard deviation (even if your software does this for you, check using the raw numbers; note that since both lists have multiple 0 values, you will need to use the corrected formula for the variance considering these ties). Check that the stated P-value of .53 is correct.