

MIDTERM EXAM (Blue)

BMED2400
Brani Vidakovic
Thursday, 3/10/2011.

Name _____

Problem	1	2	3	4	Total
Score	/25	/30	/20	/25	/100

1. Spider Monkey DNA. An 8192-long nucleotide sequence segment taken from the DNA of a spider monkey (*Ateles geoffroyi*) is provided in the file `dnatest.m`.

Find the relative frequency of thymine \hat{p}_T as an estimator of the overall population proportion, p_T .

Find a 95% confidence interval for p_T and test the hypothesis $H_0 : p_T = 1/4$ versus the alternative $H_1 : p_T \neq 1/4$. Use $\alpha = 0.05$.

2. Counts of Alpha Particles. Rutherford and Geiger provided counts of α -particles in their experiment. The counts, given in the table below, can be well modeled by Poisson distribution.

X	0	1	2	3	4	5	6	7	8	9	10	11	≥ 12
Frequency	57	203	383	525	532	408	273	139	45	27	10	4	2

- Find sample size n and sample mean \bar{X} . In calculations for \bar{X} take ≥ 12 as 12.
- Elicit a gamma prior for λ with rate parameter $\beta = 10$ and shape parameter α selected in such a way that the prior mean is 7.
- Find the Bayes estimator of λ using the prior from (b). Is the problem conjugate? Use the fact that $\sum_{i=1}^n X_i \sim \mathcal{Poi}(n\lambda)$.
- Write a WinBUGS script that simulates the Bayes estimator for λ and compare its output with the analytic solution from (c).

3. Pyruvate Kinase. Pyruvate kinase (PK) enzyme deficiency can cause hemolytic anemia since it slows down the process of glycolysis. The level of PK enzyme in healthy subjects has normal $\mathcal{N}(12, 4^2)$ distribution.

- (a) Find the probability that X falls between 5 and 11.
- (b) Find the probability that X is less than 9.
- (c) Find the value x_0 so that 93% of all PK measurements exceed x_0 .

4. Carpal Tunnel Syndrome Tests. Three commonly used tests for carpal tunnel syndrome are Tinel's sign, Phalen's test, and the nerve conduction velocity test. Tinel's sign and Phalen's test are both highly sensitive (0.97 and 0.92, respectively) and specific (0.91 and 0.88, respectively). The sensitivity and specificity of the nerve conduction velocity test are 0.93 and 0.87, respectively. Assume that the tests are independent.

(a) Calculate the sensitivity and specificity of a combined test if combining is done in a serial manner.

(b) Find PPV for the test form (a) if prevalence of carpal tunnel syndrome is approximately 50 cases per 1000 subjects in the general population.