ECE 353 Probability and Random Signals - Homework 5

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Q1. When a two-way paging system transmits a message, the probability that the message will be received by the pager it is sent to is p. When the pager receives the message, it transmits an acknowledgment signal (ACK) to the paging system. If the paging system does not receive the ACK, it sends the message again.

(a) What is the PMF of N, the number of times the system sends the same message?

(b) The paging company wants to limit the number of times it has to send the same message. It has a goal of $P[N \leq 3] \geq 0.95$. What is the minimum value of p necessary to achieve the goal?

Q2. The number of buses is B. The number of buses that arrive at a bus stop in T minutes is a Poisson random variable with the parameter λT and $\lambda = 1/5$.

(a) What is the PMF of B, the number of buses that arrive in T minutes?

(b) What is the probability that in a two-minute interval, three buses will arrive?

(c) What is the probability of no buses arriving in a 10-minute interval?

Q3. (a) Consider you go fishing. Each time you cast your line, your hook will be swallowed by a fish with probability h, independent of any other casts. What is the PMF of K, the number of fish hooked after m casts?

(b) Consider the same setup as in (a). Suppose that you cast for 6 times and each time your hook will be swallowed by a fish with probability 0.3 . What is the probability that the number of fish you caught is greater than or equal to 4?

Q4. The peak temperature T on any day in Antarctica in July is a Gaussian random variable with a variance of 225. With probability 1/2, the temperature T exceeds 10 degrees. What is $P[T > 32]$, the probability the temperature is above freezing? (Hint: here is an example of using the table. If you wish to know $\Phi(1.12)$, you should use the value on the row corresponding to 1.1 and the column corresponding to +0.02, i.e., $\Phi(1.12)$=0.86864.) (15%)

z	+0.00	+0.01	+0.02	+0.03	+0.04	+0.05	+0.06	+0.07	+0.08	+0.09
1.0	0.84134	0.84375	0.84614	0.84849	0.85083	0.85314	0.85543	0.85769	0.85993	0.86214
1.1	0.86433	0.86650	0.86864	0.87076	0.87286	0.87493	0.87698	0.87900	0.88100	0.88298
1.2	0.88493	0.88686	0.88877	0.89065	0.89251	0.89435	0.89617	0.89796	0.89973	0.90147
1.3	0.90320	0.90490	0.90658	0.90824	0.90988	0.91149	0.91308	0.91466	0.91621	0.91774
1.4	0.91924	0.92073	0.92220	0.92364	0.92507	0.92647	0.92785	0.92922	0.93056	0.93189

Table 1: Part of standard normal table

Q5. Let $X \sim \text{Exp}(\lambda)$ and $Y = \lfloor X \rfloor$.

(a) Determine whether Y is more likely to be even or odd?

(b) For what value of λ, the probability that Y is even is two times the probability that Y is odd.