9.6 QUIZ INTRODUCTION

Consider a communication system with binary input IN and binary output OUT where

1. The output of the channel is given by $y = r + v$ where
   a. $r = 0.4$ V if IN = 0.
   b. $r = 0.9$ V if IN = 1.
   c. v is a Gaussian random variable with zero mean and variance $\sigma^2 = 0.04$ V^2.
2. The binary output of the communication system, OUT, is obtained by comparing the channel output y with a threshold $T = 0.7$.
3. The binary input, IN, is equally likely to be 0 or 1.

9.6 QUIZ QUESTION 1 (1/1 point)

Under the assumptions above, what is the probability of a bit error if IN = 0? Enter the probability as a decimal number between 0 and 1 (100%).

Please key in the decimal value of your answer to the nearest thousandth in the box provided below. Use the MATLAB command window at the bottom of this page to find any required Q function values.

0.067

0.067

Answer: 0.067

EXPLANATION

$$P[\text{error}|\text{IN} = 0] = Q(\frac{T - r_{\min}}{\sigma})$$
$$= Q(\frac{0.7 - 0.4}{0.2})$$
$$= Q(1.5) \approx 0.067$$

Hide Answer *You have used 3 of 3 submissions*

9.6 QUIZ QUESTION 2 (1 point possible)

Under the assumptions above, what is the probability of a bit error if IN = 1? Enter the probability as a decimal number between 0 and 1 (100%).

Please key in the decimal value of your answer to the nearest thousandth in the box provided below. Use the MATLAB command window at the bottom of this page to find any required Q function values.

0.033

Help

0.033

Answer: 0.159

EXPLANATION:

$$P[\text{error}|\text{IN}=1] = 1 - Q(\frac{T - r_{\max}}{\sigma})$$
$$= 1 - Q(\frac{0.7 - 0.9}{0.2})$$
$$= 1 - Q(-1) \approx 0.159$$

Alternative solution using symmetry of Q function: $Q(x) = 1 - Q(-x)$

$$P[\text{error}|\text{IN}=1] = Q(\frac{r_{\max} - T}{\sigma})$$
$$= Q(\frac{0.9 - 0.7}{0.2})$$
$$= Q(1) \approx 0.159$$

Hide Answer *You have used 3 of 3 submissions*

9.6 QUIZ QUESTION 3 (1/1 point)

Under the assumptions above, what is the estimated bit error rate? Enter the rate as a decimal number between 0 and 1 (100%).

Please key in the decimal value of your answer to the nearest thousandth in the box provided below. Use the MATLAB command window at the bottom of this page to find any required Q function values.

0.113

0.113

Answer: 0.113

EXPLANATION

$$BER = P[\text{error}|\text{IN}=0] \cdot P[\text{IN}=0] + P[\text{error}|\text{IN}=1] \cdot P[\text{IN}=1]$$
$$= Q(1.5) \cdot 0.5 + (1 - Q(-1)) \cdot 0.5 \approx 0.113$$

Check Save Hide Answer *You have used 1 of 3 submissions*

9.6 QUIZ QUESTION 4 (1/1 point)

Help

Suppose that assumption #3 is changed so that the binary input, IN, is twice as likely to be 0 as 1. All other assumptions remain unchanged. Would the bit error rate change and if so, how?

Please select the correct answer.

- The BER would remain the same.
- The BER would decrease. ✔
- The BER would increase.
- There is not enough information to answer this question.

EXPLANATION

Since

$$BER = P[\text{error}|\text{IN} = 0] \cdot P[\text{IN} = 0] + P[\text{error}|\text{IN} = 1] \cdot P[\text{IN} = 1]$$

and

$$P[\text{error}|\text{IN} = 0] < P[\text{error}|\text{IN} = 1]$$

Increasing the probability that a 0 bits is transmitted would decrease the BER.

Final Check Save Hide Answer *You have used 1 of 2 submissions*

9.6 MATLAB COMMAND WINDOW

Here is a blank script for you to find the value y of Q function with given input x by using MATLAB command `y=qfunc(x)`.

```
1 y=qfunc(1.5)
2
```

Unanswered

y =

0.0668

Help

Run Code

Check

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