Quiz 2

Problem 1

1/1 point (graded)

In the generative approach to classification, how do we choose which label to give to a new point x ?

- Choose the label j that occurs most frequently, i.e., $\max(\pi_j)$
- Choose the label j whose distribution P_j assigns the highest probability to x, i.e. $\max(P_j(x))$.
- **Choose the label j that maximizes $\pi_j P_j(x)$.**
- Choose the label j for which x is the smallest number of standard deviations away from the mean of P_j

✔

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Problem 2

1/1 point (graded)

Select the correct version of Bayes' Rule from the following:

- **$P(A|B) = P(A) \times P(B|A)/P(B)$**

- $P(A|B) = P(B) \times P(B|A)/P(A)$
- $P(AB) = P(A) \times P(B|A)$
- $P(AB) = P(A) \times P(B)$

✔

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Problem 3

1/1 point (graded)

What is a probability space?

- The set of all possible outcomes for a given experiment
- The probability of an event occurring
- The set of all possible outcomes for an experiment and the probabilities of those outcomes occurring
- The domain of the probability density function

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Problem 4

3/3 points (graded)

Suppose you toss two 6-sided dice and you want to know what the probability is that the difference of their faces is equal to 3.

a) What is the size of the sample space for this problem?

- 6
- 12
- 18
- 36 ✔

b) How many events in the sample space are successful for this experiment?

- 6 ✔
- 8
- 12
- 18

c) What is the probability of this event occurring?

- $\frac{1}{36}$
- $\frac{1}{12}$
- $\frac{1}{6}$ ✔
- $\frac{1}{3}$

✔

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Problem 5

1/1 point (graded)

Suppose there are 3 bags, each containing 3 colored balls. The first two bags contain a red, green, and blue ball. The third bag contains 3 red balls. You choose a bag at random. You then pull out a ball and replace it back into the bag. You then pull out another ball and determine that both of the balls you chose were red. What is the probability you chose the bag with the 3 red balls?

- 55%
- 66%
- 71%
- 82% ✔

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Problem 6

1/1 point (graded)

A particular classification task has three possible labels. Which of the following three features is likely to be the most useful for determining which label should be given to a new data point, based on the Gaussian distributions given?

Feature 1:

Label 1 ~ N(2, 4)

Label 2 ~ N(1, 1)

Label 3 ~ N(3, 6.25)

Feature 2:

Label 1 ~ N(1, 1)

Label 2 ~ N(1, 0.56)

Label 3 ~ N(1, 1.27)

Feature 3:

Label 1 ~ N(4, 0.25)

Label 2 ~ N(2, 1)

Label 3 ~ N(8, 0.25)

- ○ Feature 1
- ○ Feature 2
- ◉ Feature 3

✔

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Problem 7

3/3 points (graded)

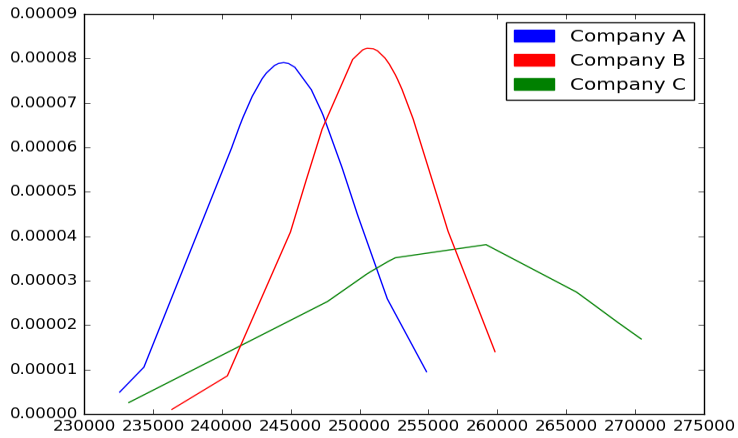
Let's say you are building a replica of your expensive electric guitar. You wish to use the same electronic hardware as your old guitar uses but none of the parts are labeled with their manufacturer. You know that three companies sell potentiometers to your guitar's

maker: company A, company B, and company C. You happen to have a training set of potentiometers from the three companies, consisting of 22 from A, 25 from B and 14 from C.

From your set of potentiometers, what is the probability, π_B, that company B manufactured a particular potentiometer?

- 22%
- 32%
- **41%** ✔
- 55%

You decide to analyze the feature of "maximum resistance" to try to determine the manufacturer of your old potentiometer. After analyzing your training set, you find that company A's potentiometers have an average maximum resistance of $244k\Omega$ with a standard deviation of $6.2k\Omega$, company B's are $251k\Omega$ with a standard deviation of $4.1k\Omega$, and company C's are $261k\Omega$ with a standard deviation of $11.1k\Omega$. The distribution functions are shown:



You also find that your old potentiometer has a maximum resistance of $248k\Omega$. Based on this information, which company can you conclude manufactured your old potentiometer?

- Company A
- Company B
- Company C
- Cannot reliably determine ✔

✔

If your old potentiometer instead had a maximum resistance of $269k\Omega$, which company could you reasonably conclude was the manufacturer?

- Company A
- Company B
- Company C ✔
- Cannot reliably determine

✔

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Problem 8

2/2 points (graded)

Suppose you flip 3 fair coins and you let the random variable, X, be the number of tails.

How many different values can X take on?

- 2

- 3
- 4
- 8

✔

What is the probability that $X = 2$?

- 0.125
- 0.25
- 0.375
- 0.5

✔

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Problem 9

1/1 point (graded)

Let's say you have an unusual 6-sided die, in which four of the sides show a 1 and the other 2 sides show a 6. If X is the value shown on the die, what is the expected value and variance of X?

- $E[X] = 3.5, Var[X] = 2.92$
- $E[X] = 3.5, Var[X] = 6.94$

- (selected) $E[X] = 2.67, Var[X] = 5.55$
- $E[X] = 2.67, Var[X] = 2.36$

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Problem 10

1/1 point (graded)

True or False:

$$Var[X] = E[(X - \mu)^2]$$

where $\mu = E[X]$

- (selected) True
- False

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Problem 11

4/4 points (graded)

You are given the following joint probability distribution (X values along the left column, Y values along the top row):

X/Y	2	4	6
1	0.2	0.08	0.12

3	0.1	0.04	0.06
5	0.2	0.08	0.12

What is the probability that $X = 1$?

- 0.2
- 0.4
- 0.5
- 0.6

✔

What is the probability that $Y = 6$?

- 0.12
- 0.18
- 0.3
- 0.4

✔

What is the probability that $X = 1$ and $Y = 6$?

- 0.12
- 0.17

- 0.3
- 0.4

✔

Are X and Y independent?

- Yes
- No

✔

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Problem 12

1/1 point (graded)

Select the correct version of the correlation coefficient.

- $\rho_{X,Y} = \frac{Cov[X,Y]}{E[X]E[Y]}$
- $\rho_{X,Y} = \frac{Cov[X,Y]}{Var[X]Var[Y]}$
- $\rho_{X,Y} = \frac{Cov[X,Y]}{Std[X]Std[Y]}$
- $\rho_{X,Y} = \frac{Cov[X,Y]}{E[XY]}$

✔

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Problem 13

1/1 point (graded)

True or False: If X and Y are independent random variables, then their covariance is 0 and the correlation coefficient is also 0.

- (•) True
- ( ) False

✔

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Problem 14

1/1 point (graded)

Given the following joint probability distribution, find the correlation coefficient.

X/Y	-1	1
1	0.1	0.4
3	0.4	0.1

- ( ) $\rho = 0.00$
- ( ) $\rho = -0.29$
- (•) $\rho = -0.60$

- $\rho = 0.34$

✔

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Problem 15

1/1 point (graded)

Which of the following statements are true for a bivariate Gaussian distribution?

- [x] The density is highest at the mean
- [ ] The bivariate Gaussian is fully parameterized by the mean and standard deviation for each variable
- [ ] The contour lines of the density are concentric circles
- [x] The contour lines represent specific probability density values

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Problem 16

1/1 point (graded)

What does the covariance matrix, $\Sigma = \begin{pmatrix} 9 & 0 \\ 0 & \frac{1}{4} \end{pmatrix}$ indicate about the contour lines for the density function?

- [ ] They are centered at $(9, \frac{1}{4})$

- [ ] They are centered at $(3, \frac{1}{2})$
- [x] The contour lines are aligned with the coordinate axes
- [x] They are stretched 6 times further in the x_1-direction than in the x_2-direction

✔

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Problem 17

1/1 point (graded)

True or false: If covariance between two variables is positive, then they must be positively correlated.

- (•) True
- ( ) False

✔

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Problem 18

1/1 point (graded)

True or false: the elements $\Sigma_{1,2}$ and $\Sigma_{2,1}$ of the covariance matrix must be equal.

- (•) True
- ( ) False

✔

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