Marcus Blaisdell
CptS 440
Homework #10
November 15, 2018
Dr. Holder

1.
a.
P(Sail=yes) = 7/10 = 0.7
P(Sail=no) = 3/10 = 0.3

b.
P(Sky|Sail) for all values of Sky ∈ {clear, cloudy, overcast} and Sail ∈ {yes, no}

$$P(Sky|Sail) = \frac{P(Sky \text{ ^ } Sail)}{P(Sail)}$$

P(clear|yes) = (2/10)/(7/10) = 2/7 = 0.2857
P(cloudy|yes) = (3/10)/(7/10) = 3/7 = 0.4286
P(overcast|yes) = (2/10)/(7/10) = 2/7 = 0.2857
P(clear|no) = (1/10)/(3/10) = 1/3 = 0.3333
P(cloudy|no) = (1/10)/(3/10) = 1/3 = 0.3333
P(overcast|no) = (1/10)/(3/10) = 1/3 = 0.3333

c.
P(Sea|Sail) for all values of Sea ∈ {blue, gray} and Sail ∈ {yes, no}

$$P(Sea|Sail) = \frac{P(Sea \text{ ^ } Sail)}{P(Sail)}$$

P(blue|yes) = (5/10)/(7/10)= 5/7 = 0.7143
P(gray|yes) = (2/10)/(7/10)= 2/7 = 0.2857
P(blue|no) = (0/10)/(3/10)= 0/3 => (0 + 1)/ (3 + 2) = 1/5 = 0.2
P(gray|no) = (3/10)/(3/10)= 3/3 = 1

d.
P(Sun|Sail) for all values of Sun ∈ {true, false} and Sail ∈ {yes, no}

$$P(Sun|Sail) = \frac{P(Sun \text{ ^ } Sail)}{P(Sail)}$$

P(true|yes) = (4/10)/(7/10) = 4/7 = 0.5714
P(false|yes) = (3/10)/(7/10) = 3/7 = 0.4286
P(true|no) = (0/10)/(3/10) = 0/3 => (0 + 1)/(3 + 2) = 1/5 = 0.2
P(false|no) = (3/10)/(3/10) = 3/3 = 1

e.
P(Sail=yes | Sky=overcast, Sea=gray, Sun=true) =
= P(Sail=yes) Π P(Sky=overcast | Sail=yes) P(Sea=gray | Sail=yes) P(Sun=true | Sail=yes)
= (7/10) * (2/7) * (2/7) * (4/7) = α0.032653

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P(Sail=no | Sky=overcast, Sea=gray, Sun=true) =
= P(Sail=no) Π P(Sky=overcast | Sail=no) P(Sea=gray | Sail=no) P(Sun=true | Sail=no)
= (3/10) * (1/3) * (3/3) * (1/5) = α0.02

so:
P(Sail | Sky=overcast, Sea=gray, Sun=true) = α<0.032653, 0.02>
α = 1/(0.032653 + 0.02) = 18.9922
P(Sail | Sky=overcast, Sea=gray, Sun=true) = <0.62, 0.38>

therefore:
P(Sail=yes | Sky=overcast, Sea=gray, Sun=true) = 0.62
P(Sail=no | Sky=overcast, Sea=gray, Sun=true) = 0.38

f.
0.62 > 0.38
Naïve Bayes would choose Sail = yes

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2.

a.

| Sky | Sea | Sun | Sail |
|---|---|---|---|
| 0 | 0 | 0 | Yes |
| 0 | 1 | 1 | Yes |
| 0 | 1 | 0 | No |
| 1 | 0 | 1 | Yes |
| 1 | 0 | 0 | Yes |
| 1 | 1 | 1 | Yes |
| 1 | 1 | 0 | No |
| 2 | 0 | 1 | Yes |
| 2 | 0 | 0 | Yes |
| 2 | 1 | 0 | No |

b.

New instance: <Sky=overcast, Sea=gray, Sun=true> => <Sky=2, Sea=1, Sun=1>

Euclidean distance between 3-dimensional points = $\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}$

$(x_1, y_1, z_1) = (2, 1, 1)$ (the new instance values)

| Line | Calculation | Distance | Class |
|---|---|---|---|
| 1 | $\sqrt{(2-0)^2 + (1-0)^2 + (1-0)^2} = \sqrt{6} = 2.45$ | 2.45 | Yes |
| 2 | $\sqrt{(2-0)^2 + (1-1)^2 + (1-1)^2} = 2$ | 2 | Yes |
| 3 | $\sqrt{(2-0)^2 + (1-1)^2 + (1-0)^2} = \sqrt{5}$=2.24 | 2.24 | No |
| 4 | $\sqrt{(2-1)^2 + (1-0)^2 + (1-1)^2} = \sqrt{2}$=1.41 | 1.41 | Yes |
| 5 | $\sqrt{(2-1)^2 + (1-0)^2 + (1-0)^2} = \sqrt{3}$=1.73 | 1.73 | Yes |
| 6 | $\sqrt{(2-1)^2 + (1-1)^2 + (1-1)^2} = 1$ | 1 | Yes |
| 7 | $\sqrt{(2-1)^2 + (1-1)^2 + (1-0)^2} = \sqrt{2}$=1.41 | 1.41 | No |
| 8 | $\sqrt{(2-2)^2 + (1-0)^2 + (1-1)^2} = 1$ | 1 | Yes |
| 9 | $\sqrt{(2-2)^2 + (1-0)^2 + (1-0)^2} = \sqrt{2}$=1.41 | 1.41 | Yes |
| 10 | $\sqrt{(2-2)^2 + (1-1)^2 + (1-0)^2} = 1$ | 1 | No |

c.

3 nearest neighbors, there are three points at distance 1, two are yes, one is no, majority of nearest neighbors are yes, so yes.

3NN would classify <Sky=overcast, Sea=gray, Sun=true> as Yes

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d.

7 nearest neighbors: 1:yes, 1:yes, 1:no, 1.41:yes, 1.41:no, 1.41:yes, 1.73:yes
5 yes'es, 2 no's

7NN would classify <Sky=overcast, Sea=gray, Sun=true> as Yes