Naive Bayes

(find and work with a partner)

Say we have two tests for a specific disease. Each test (features f_1, f_2) can come back either positive "pos" or negative "neg", and the true underlying condition of the patient is represented by y ($y = 1$ is "healthy" and $y = 2$ is "disease"). We observe this training data where $n = 7$ and $p = 2$:

$\boldsymbol{x}$	f_1	f_2	y
$\boldsymbol{x}_1$	pos	neg	1
$\boldsymbol{x}_2$	pos	pos	2
$\boldsymbol{x}_3$	pos	neg	2
$\boldsymbol{x}_4$	neg	neg	1
$\boldsymbol{x}_5$	pos	neg	2
$\boldsymbol{x}_6$	neg	neg	1
$\boldsymbol{x}_7$	neg	pos	2

1. To estimate the probability $p(y = k)$, for $k = 1, 2, \cdots, K$, we will use the formula:

$$\theta_k = \frac{N_k + 1}{n + K}$$

where N_k is the count ("Number") of data points where $y = k$. Compute θ_1 and θ_2. What would θ_1 and θ_2 be if we in fact had *no* training data?

2. To estimate the probabilities $p(x_j = v|y = k)$ for all features j, values v, and class label k, we will use the formula:

$$\theta_{k,j,v} = \frac{N_{k,j,v} + 1}{N_k + |f_j|}$$

where $N_{k,j,v}$ is the count of data points where $y = k$ and $x_j = v$, and $|f_j|$ is the number of possible values that f_j (feature j) can take on. Fill in the following tables with these θ values.

$y = 1$	pos	neg
f_1		
f_2		

$y = 2$	pos	neg
f_1		
f_2		