

1. Model #1 is underfitting because both the training and validation error remains constant and relatively high. Common causes of underfitting are using too simple of a model, a lot of noise in the data, not enough training data and using limited features. Some solutions to fix an underfitting model are reducing noise, using a more complex model, using more features or engineer new features, increase training data and regularization.

Model #2 is perfect because, both the training error and validation error are decreasing in a stable manner with the generalization gap being consistent.

Model #3 is overfitting because the training starts going up. Common causes of overfitting are overly complex models, not enough training data, and not regularizing. Some solutions to fix an overfitting model are regularization, cross-validation, feature reducing techniques such as PCA, ensemble methods and early stopping.

2.

COLOUR	stolen		Type	stolen		origin	stolen		stolen
	yes	no		yes	no		yes	no	
Red	3	2	Sports	4	2	Domestic	2	3	yes
Yellow	2	3	SUV	1	3	Imported	3	2	No
total	5	5	total	5	5	total	5	5	total

$$P(\text{Yes} | \text{Red, Domestic, SUV}) = \frac{P(\text{Red, Domestic, SUV} | \text{yes}) \times P(\text{yes})}{P(\text{Red, Domestic, SUV})}$$

$$P(\text{Red} | \text{Yes}) = \frac{3}{5}$$

$$P(\text{Domestic} | \text{Yes}) = \frac{2}{5}$$

$$P(\text{SUV} | \text{Yes}) = \frac{1}{3}$$

$$P(\text{Yes}) = \frac{1}{2}$$

$$P(\text{Red}) = \frac{1}{2}$$

$$P(\text{Domestic}) = \frac{1}{2}$$

$$P(\text{SUV}) = \frac{2}{5}$$

$$P(\text{Red} | \text{No}) = \frac{2}{5}$$

$$P(\text{Domestic} | \text{No}) = \frac{3}{5}$$

$$P(\text{SUV} | \text{No}) = \frac{3}{5}$$

$$P(\text{No}) = \frac{1}{2}$$

$$P(\text{Not Red, Domestic, SUV}) = \frac{\frac{2}{5} \times \frac{3}{5} \times \frac{3}{5} \times \frac{1}{2}}{\frac{1}{2} \times \frac{1}{2} \times \frac{2}{5}} = \frac{18}{250} = \frac{180}{2500} = 0.072$$

$$P(\text{Yes} | \text{Red, Domestic, SUV}) = \frac{0.24}{0.24 + 0.72} = 0.25$$

$$P(\text{No} | \text{Red, Domestic, SUV}) = 1 - 0.25 = 0.75$$

∴ less likely to be stolen