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Assignment #2

Chapter 4 Question 6

→ Data on students in a statistics class
$[X_1]$ = hours studied $[X_2]$ = undergrad gpa Y = receive an A
↳ logistic regression
$\beta_0 = -6$, $\beta_1 = .05$ $\beta_2 = 1$

a) Probability that student studies 40 hr. has GPA 3.5 gets an A
↳ logistic regression - equation

$$P_r(Y=1|X=x) = \frac{1}{1+e^{-(\beta_0+\beta_1 X_1+\beta_2 X_2)}}$$

→ with $X_1 = 40$ and $X_2 = 3.5$, probability of student getting an A is .378

b) Same student, how many hours of study to have 50% chance?
↳ would need to study for **50 hours**

$$.5 = \frac{1}{1+e^{-(\beta_0+\beta_1 X_1+\beta_2 X_2)}}$$

$$\left[.5e^{-(\beta_0+\beta_1 X_1+\beta_2 X_2)} = .5\right] \ln$$

$$-(-6+.05X_1+3.5) = \ln(1) = 0$$

$$-2.5+.05X_1 = 0$$

$$.05X_1 = 2.5$$

$$\boxed{X_1 = 50}$$

Chapter 4 Problem 7

→ Predict Yes/No on dividend based on last year's profit
↳ for no, $\bar{X} = 0$ for yes, $\bar{X} = 10$
σ^2 for both = 36
→ assume X follows normal dist, predict prob that a company will give dividend given % profit has $X = 4$

→ density function for normal random variable is $f(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-(x-\mu)^2/2\sigma^2}$

Bayes Theorem:

$$Pr(y=1 \mid X=4) = \frac{\pi_K f_K(x)}{\sum_{l=1}^{K} \pi_l f_l(x)}$$

π = marginal probabilities μ = in class means
σ^2 = common variance

note: 80% companies issued dividend,

$\therefore \pi_0 = .2 \quad \pi_1 = .8$

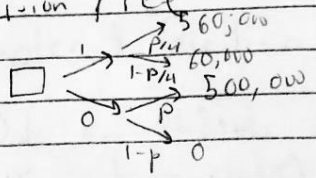
$$Pr(y=1 \mid X=4) = \frac{\pi_1 f_1(4)}{\pi_1 f_1(4) + \pi_0 f_0(4)}$$

$f_1(4) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-(X-\mu)^2/2\sigma^2}$ where $\sigma^2=36, \mu=10, X=4$
$f_1(4) = .0403$

$f_0(4) =$ " where $\sigma^2=36, \mu=0, X=4$
$f_0(4) = .0532$

$$Pr(y=1 \mid X=4) = \frac{\pi_1 f_1(4)}{\pi_1 f_1(4) + \pi_0 f_0(4)} = \frac{.8(.04)}{.8(.04)+.2(.05)} = \boxed{.7518}$$

Decision Tree



To find break even point, find cost of no prescribe = cost of prescribe

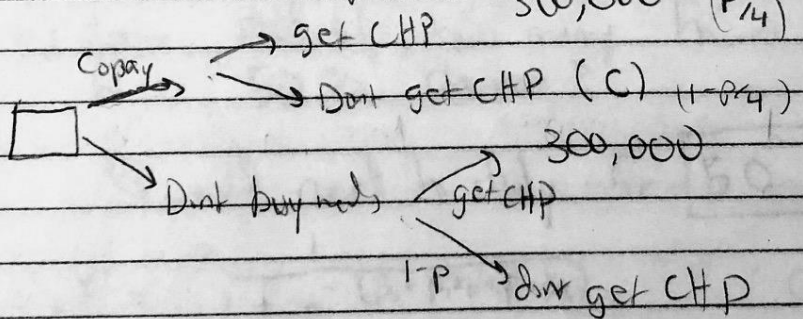
$$\therefore \quad p(500,000) = (1 - P/4)60,000 + \frac{P}{4}(560,000)$$

$$500,000p = 60,000 - 15,000p + 140,000p$$

$$500,000p = 60,000 + 125,000p$$

$$375,000p = 60,000 \qquad p = .16$$

Decision tree for patients



set the sides equal and solve for C

$$(C + 300,000).04 + C(.96) = 300,000(.16) + \cancel{0(.84)}$$

$$C + 300,000(.04) = 300,000(.16)$$

$$C = 300,000(.16 - .04) = 300,000(.12) = 36,000$$