

Election Day 2023 – Solutions

Answer the following questions:

1. How many elements should the $\mathbf{P}(Y)$ vector have? And what *is* $\mathbf{P}(Y)$?

Answer: two elements: $\langle .6, .4 \rangle$.

2. How many elements should the $\mathbf{P}(D,B)$ vector have? And what *is* $\mathbf{P}(D,B)$?

Answer: four elements: $\langle .04 + .12, .2 + .04, .06 + .18, .3 + .06 \rangle$, or $\langle .16, .24, .24, .36 \rangle$

3. What are the values of $P(y|b)$ and $P(\neg y|b)$?

Answer $\frac{.04+.06}{.04+.06+.12+.18}$ (which is .25) and $\frac{.12+.18}{.04+.06+.12+.18}$ (which is .75).

4. How many elements should the $\mathbf{P}(Y|B)$ vector have? And what *is* $\mathbf{P}(Y|B)$?

Answer: $\langle \frac{.04+.06}{.04+.06+.12+.18}, \frac{.2+.3}{.2+.3+.04+.06}, \frac{.12+.18}{.04+.06+.12+.18}, \frac{.04+.06}{.2+.3+.04+.06} \rangle = \langle .25, .833, .75, .167 \rangle$.

5. How many elements should the $\mathbf{P}(B|D)$ vector have? And what *is* $\mathbf{P}(B|D)$?

Answer: $\langle \frac{.04+.12}{.04+.2+.12+.04}, \frac{.06+.18}{.06+.3+.18+.06}, \frac{.2+.04}{.04+.2+.12+.04}, \frac{.3+.06}{.06+.3+.18+.06} \rangle = \langle .4, .4, .6, .6 \rangle$.

6. Are the random variables B and D independent?

Answer: Yes, since $P(b) = .4$ and $P(b|d)$ is also .4. So if you told me someone did (or did not) like Dune, that doesn't tell me anything about whether they like Biden.

7. Are the random variables Y and B independent?

Answer: No, since $P(y) = .6$ but $P(y|b)$ is only .25. So the majority of people like Youngkin (60% of all voters), but the majority of Biden supporters do not (only 25% of Biden voters).