Conditional Probability
Excel Spreadsheet Calculations

From the conditional probabilities $\mathrm{P}[A \mid B]$, $\mathrm{P}\left[A \mid \tilde{B}\right]$ and the unconditional probability $\mathrm{P}[B]$ (in the input cells B4, B5, B6), all of the other 13 probabilities in the "Cond Prob" spreadsheet can be found as follows:

From complementary events:

$\mathrm{P}\left[\tilde{A} \mid B\right] = 1 - \mathrm{P}[A \mid B]$ (cell F4 = 1–B4)

$\mathrm{P}\left[\tilde{A} \mid \tilde{B}\right] = 1 - \mathrm{P}\left[A \mid \tilde{B}\right]$ (cell F5 = 1–B5)

$\mathrm{P}\left[\tilde{B}\right] = 1 - \mathrm{P}[B]$ (cell F6 = 1–B6)

Joint Probabilities:

By the general multiplication law of probability:

$\mathrm{P}[AB] = \mathrm{P}[A \mid B] \cdot \mathrm{P}[B]$ (cell J4 = B4*B6)

$\mathrm{P}\left[A\tilde{B}\right] = \mathrm{P}\left[A \mid \tilde{B}\right] \cdot \mathrm{P}\left[\tilde{B}\right]$ (cell J6 = B5*F6)

From the total probability law:

$\mathrm{P}[B] = \mathrm{P}[AB] + \mathrm{P}\left[\tilde{A}B\right] \Rightarrow \mathrm{P}\left[\tilde{A}B\right] = \mathrm{P}[B] - \mathrm{P}[AB]$ (cell J5 = B6–J4)

$\mathrm{P}\left[\tilde{B}\right] = \mathrm{P}\left[A\tilde{B}\right] + \mathrm{P}\left[\tilde{A}\tilde{B}\right] \Rightarrow \mathrm{P}\left[\tilde{A}\tilde{B}\right] = \mathrm{P}\left[\tilde{B}\right] - \mathrm{P}\left[A\tilde{B}\right]$ (cell J7 = F6–J6)

$\mathrm{P}[A] = \mathrm{P}[AB] + \mathrm{P}\left[A\tilde{B}\right]$ (cell B8=J4+J6)

From complementary events:

$\mathrm{P}\left[\tilde{A}\right] = 1 - \mathrm{P}[A]$ (cell F8=1–B8)

Conditional Probabilities:

$\mathrm{P}[B \mid A] = \dfrac{\mathrm{P}[AB]}{\mathrm{P}[A]}$ (cell B9=J4/B8)

$\mathrm{P}\left[B \mid \tilde{A}\right] = \dfrac{\mathrm{P}\left[\tilde{A}B\right]}{\mathrm{P}\left[\tilde{A}\right]}$ (cell B10=J5/F8)

From complementary events:

$\mathrm{P}\left[\tilde{B} \mid A\right] = 1 - \mathrm{P}[B \mid A]$ (cell F9=1–B9)

$\mathrm{P}\left[\tilde{B} \mid \tilde{A}\right] = 1 - \mathrm{P}\left[B \mid \tilde{A}\right]$ (cell F10=1–B10)

Columns C, G and K contain the same 16 values expressed as fractions, where possible.

Bayes' theorem may be used instead. For example,

$$\mathrm{P}[B \mid A] = \frac{\mathrm{P}[A \mid B] \cdot \mathrm{P}[B]}{\mathrm{P}[A \mid B] \cdot \mathrm{P}[B] + \mathrm{P}\left[A \mid \tilde{B}\right] \cdot \mathrm{P}\left[\tilde{B}\right]} = \frac{\mathrm{P}[A \mid B] \cdot \mathrm{P}[B]}{\mathrm{P}[A \mid B] \cdot \mathrm{P}[B] + \mathrm{P}\left[A \mid \tilde{B}\right] \cdot \left(1 - \mathrm{P}[B]\right)}$$