Module 2E Questions:

1. The words "you have won" are sometimes used in emails (5%). Most emails are not spam, but let's say a person has a 2% chance of receiving spam mail. In addition, 80% of spam emails have the words "you have won" in them compared to 10% of non-spam emails. Use Bayes' Theorem to calculate the probability that an email with the words "you have won" is spam.

2. *Suppose you work in a psychiatric institution, and a patient is referred to you by the GP because of an elevated score on a depression questionnaire.*

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*In the practice of this GP, **10%** of patients have depression (the '**prevalence'** of the disorder).*

*If a patient has depression, the likelihood that they have a positive score on this depression questionnaire is **90%**.*

*A patient who does not have depression has an **80%** chance of a negative score.*

WHAT IS YOUR ESTIMATE THAT THE PATIENT HAS DEPRESSION GIVEN THAT THEY HAVE A POSITIVE TEST? What about if they have a negative test? Note: show your work for this question. The answer is in the module videos/PowerPoints, but it is more useful to see ***how*** *you solved it, than to note the answer is correct*.

3. Answer any **two** of the following questions. For each one, you will do three things:
   1. fill out a Bayes table using a cohort of 10,000 people
   2. compute PPV and NPV, and
   3. discuss how changing **prevalence** would alter the posterior.

   Quick reference

   PPV = $P(Disease \mid +) = \frac{TP}{TP+FP}$

   NPV = $P(No\ disease \mid -) = \frac{TN}{TN+FN}$

   Use a **10,000** population for clean integers.

   Using counts instead of percentages can be helpful!

   Scenario A:
   Rare disease, decent test:
   - Prevalence: 1%
   - Sensitivity: 90%
   - Specificity: 95%

Scenario B:

Higher prevalence, weaker specificity

- **Prevalence:** 10%
- **Sensitivity:** 95%
- **Specificity:** 90%

Scenario C:

High specificity, moderate sensitivity

- Prevalence: 20%
- Sensitivity: 80%
- Specificity: 99%

Scenario D:

Screening: Catch almost everything

- Prevalence: 2%
- Sensitivity: 99%
- Specificity: 85%