Problem 1:

1. S
2. S
3. S
4. S
5. S
6. S
7. S
8. S

Problem 2:

1. GitHub Repository: <https://github.com/nataliecar/cognitive-modeling/tree/main>
2. Merge conflict on GitHub.
3. Explain differences:
4. git restore
5. git checkout
6. git reset
7. git revert

Problem 3:

Work

Problem 4:

1. We will show the following:
2. We will show the following:
3. We will show the transformation:

Suppose we have a normal distribution with and . We want to get to a new normal distribution with and .

We can apply the following linear transformation to do this:

We can use this linear transformation with and :

There is a Jupyter notebook on the GitHub that demonstrates this result.

Problem 5:

Let be a random variable that signifies if the statement is the truth or a lie. We have that . Let be the probability that “yes” response is true.

We know the following information:

We need to find the probability of the statement being true. Thus, we need to find .

We can do this using Bayes’ Rule:

We can find using the sum and product rules:

Therefore, we have the following probability:

There is a probability of that the statement was true.

Problem 6:

Work (code in repo)

Problem 7:

First, we will discuss how the posterior probability changes as a function of the prior probability. We see from the simulation that the curve of this relationship is logarithmic. This means that as the prior probability initially increases, the posterior probability quickly increases, but as the prior probability gets larger, the posterior probability increases at a slower rate.

Next, we will discuss how the posterior probability changes as a function of the sensitivity. We see from the simulation that the curve of this relationship is linear. This means that as the sensitivity increases, the posterior probability quickly increases, and that the rate at which the posterior probability increases stays constant.

Lastly, we will discuss how the posterior probability changes as a function of the specificity. We see from the simulation that the curve of this relationship is exponential. This means that as the prior probability initially increases, the posterior probability slowly increases, but as the prior probability gets larger, the posterior probability increases at a faster rate.

There is a Jupyter notebook on the GitHub showing these 2D graphs as well as the 3D graphs for the bonus.

Problem 8: There is a Jupyter notebook on the GitHub that contain this problem’s solution.

Problem 9:

We used ChatGPT 3.5 to generate the function. We also specified that it does not use any SciPy functions when creating its function. It performed very well because it gave practically the exact same answer as SciPy’s function did. The differences between ChatGPT and SciPy were on orders of magnitude such around . This good performance was consistent across all three Gaussian types. A Jupyter notebook with ChatGPT’s function and the comparisons to SciPy are on the GitHub.