How Measurement Decision Theory Works

We are using Measurement Decision Theory (MDT) to establish the standard diplomates should meet for MOCA Minute® to demonstrate they are maintaining their specialty-specific knowledge. To understand how the MOCA Minute questions and the MDT model work together to create a robust assessment method, let's look at an example.

Dr. Able is participating in MOCA Minute. The MDT model begins with an initial probability estimate of 0.97 (or 97%) that Dr. Able is keeping her anesthesiology knowledge current. We know based on a decade of MOCA Exam scores that 97% of diplomates keep their specialty-specific knowledge current because they passed the exam. So, there is a 97% probability that Dr. Able is keeping up-to-date.

Now suppose that Dr. Able answers four MOCA Minute questions and that her responses to the questions are as shown in this table.

		Group 1: Diplomates keeping their knowledge up-to-date	Group 2: Diplomates NOT keeping their knowledge up-to-date
Question ID	Dr. Able's Response	Question Difficulty Value	Question Difficulty Value
19862	✓	0.73	0.53
20054	✗	0.55	0.35
19953	✓	0.58	0.38
19621	✓	0.80	0.60

You can see that the questions' difficulty levels vary, with larger values indicating easier questions and smaller values indicating more difficult ones. You can also see that the difficulty of each question depends on whether the diplomates are keeping their knowledge up-to-date.

Dr. Able's answers give us new information we can use to update our previous estimate that she is keeping her knowledge current.

The first thing we'll need to do is assign a different value to Dr. Able's responses depending on whether she answered each question correctly or incorrectly. We'll need to assign values under two possible group classifications: one classification assumes that she belongs with the group that is keeping their knowledge up-to-date. Let's call this Group 1. The other classification assumes that she belongs to the group that is not keeping their knowledge up-to-date. Let's call this Group 2. Dr. Able's responses are assigned values equal to the difficulty value of the question for a correct answer or 1 minus the difficulty value of the question for incorrect answers. You can see the assigned values for each of Dr. Able's responses given each of the possible group classification assumptions.

		Group 1: Diplomates keeping their knowledge up-to-date		Group 2: Diplomates NOT keeping their knowledge up-to-date	
Question ID	Dr. Able's Response	Question Difficulty Value	Value Assigned	Question Difficulty Value	Value Assigned
19862	✓	0.73	0.73	0.53	0.53
20054	✗	0.55	0.45	0.35	0.65
19953	✓	0.58	0.58	0.38	0.38
19621	✓	0.80	0.80	0.60	0.60

To update our initial probability estimate that Dr. Able is keeping her knowledge current based on her responses to these four questions, we first need to multiply the value assigned for each question. We would do this for Groups 1 and 2 separately.

Group 1: Up-to-Date: **0.73 * 0.45 * 0.58 * 0.80 = 0.15**

Group 2: Not Up-to-Date: **0.53 * 0.65 * 0.38 * 0.60 = 0.08**

Next we need to "weight" these products based on the proportion of all diplomates we believe belong to each of these groups. Remember, based on diplomates' MOCA Exam performance, we know that 97% of MOCA participants belong to **Group 1: Up-to-Date** and just 3% belong to **Group 2: Not Up-to-Date**. To calculate the weighted product, we multiply the unweighted products by the proportion of all diplomates who we believe belong to each group.

Group 1: Up-to-Date: **0.15 * 0.97 = 0.146**

Group 2: Not Up-to-Date: **0.08 * 0.03 = 0.002**

Our final step is to convert these two weighted products into probabilities. We do this by adding the weighted products ...

Sum of the Weighted Products: **0.146 + 0.002 = 0.148**

…and then dividing each weighted product by the sum.

Group 1: Up-to-Date Probability Estimate: **0.146 ÷ 0.148 = 0.986**

Group 2: Not Up-to-Date Probability Estimate: **0.002 ÷ 0.148 = 0.014**

So, what does this mean? How do we interpret these results? Well, Dr. Able's MOCA Minute responses reinforce our initial belief that she is keeping her knowledge current. Given the additional information gleaned from her MOCA Minute responses, we would increase our probability estimate from a 0.97 or 97% to a 0.985 or 98.5% probability that Dr. Able is staying up-to-date.

In this example, we calculated our initial probability estimate for Dr. Able based on the set of her four question responses. However, in reality, the MDT algorithm recalculates the probability estimate after each MOCA Minute question she answers. The advantage of this is that the change in the probability estimate can be displayed graphically so that she can easily monitor trends in her MOCA Minute question response pattern over time.