1.

> I have a jar that contains one liter of oil and another jar with one liter of vinegar. I take one tablespoon of oil from the oil jar and add it to the vinegar jar. (Don't worry. Nothing spills.) I then mix the oil with the vinegar (I might not do a very good mixing job) and transfer one tablespoon of the mixture back to the oil jar. What is true about the fraction of oil in the oil jar compared to the fraction of vinegar in the vinegar jar? and why?

The fraction of oil to vinegar in the oil jar is equal to the fraction of vinegar to oil in the vinegar jar. This happens since the total volume of both is equal since you're transferring the exact same amount of liquid between the jars.

$$vol_1 = vol_2$$
$$vol_{oil} = 1$$
$$vol_{vinegar} = 1$$

If there is some v amount of oil in the vinegar jar, for the volumes to be the same, there must also be some v amount of vinegar in the oil jar.