Car Trouble

Purpose:
Participants will use conditional probability to determine the chance of getting a good car repair job.

Overview:
In pairs, participants will use probability to determine aspects of their car repair given information about the productivity and quality of work done by the two mechanics in the auto repair shop.

TExES Mathematics 4-8 Competencies. The beginning teacher:

IV.013.B Uses the concepts and principles of probability to describe the outcome of simple and compound events.
IV.013.C Generates, simulates, and uses probability models to represent a situation.
IV.013.D Determines probabilities by constructing sample spaces to model situations.

TEKS Mathematics Objectives. The student is expected to:

4.13.A List all possible outcomes of a probability experiment such as tossing a coin.
4.13.B Use a pair of numbers to compare favorable outcomes to all possible outcomes.
5.12.A Use fractions to describe the results of an experiment.
6.9.A Construct sample spaces using lists, tree diagrams, and combinations.
6.9.B Find the probabilities of a simple event and its complement and describe the relationships between the two.
7.10.A Construct sample spaces for compound events (dependent and independent). ???
7.11.B Make inferences and convincing arguments based on an analysis of given or collected data.
8.11.A Find the probabilities of compound events (dependent and independent). ???
8.11.B Use theoretical probabilities and experimental results to make predictions and decisions.

Terms.
Conditional probability, sample space, complement of an event

Materials.
- Transparency
- Activity Sheet for each participant

Transparencies.
- *Car Trouble*
- *More Car Trouble*

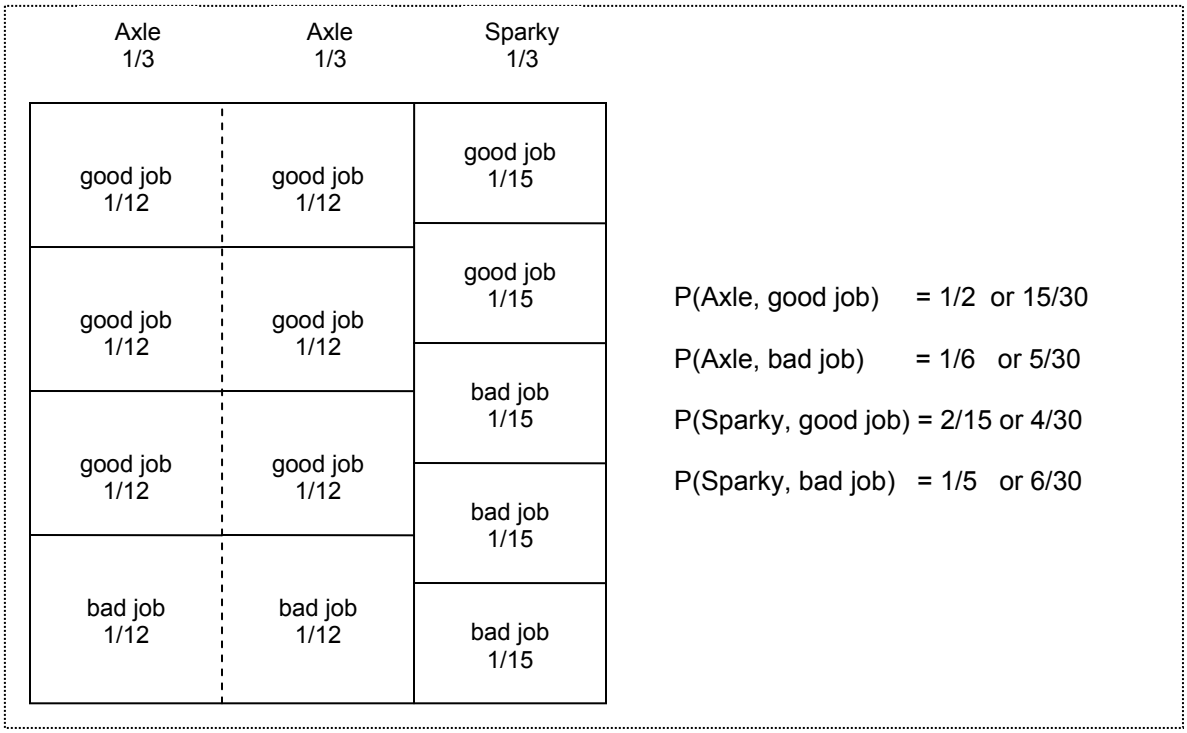
Activity Sheet(s).
- *Car Trouble*
- *More Car Trouble*

Procedure:

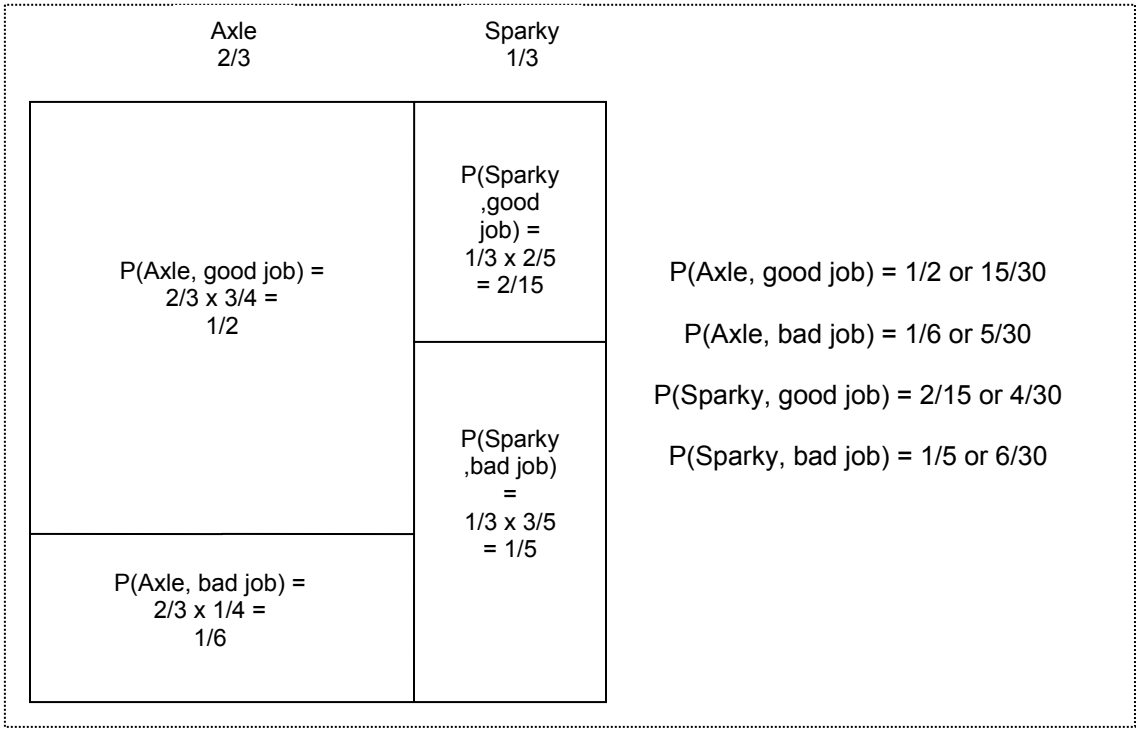
Steps	Questions/Math Notes
1. Read aloud the *Car Trouble* problem (Transparency) two times. Ask participants to work in pairs to answer the given questions about their auto repairs.	To stimulate their thinking, ask participants questions about what they are doing: *What is the sample space for this problem? Is this a finite or infinite sample space? Explain.*
2. Circulate among the groups as they work the problem. Ask participants to draw an area model or a tree diagram to represent the Car Trouble problem.	*What are all the possible outcomes? How do you know?* *Which model (area model or tree diagram) will you choose to construct? Why?* *How many sections are needed for your area model?* *How many branches are needed for your tree diagram?* *Which questions include conditional statements and thus require the use of conditional probability?* *How are questions #3 and #4 (Activity Sheet) different? Explain.* *What is the condition in question #3?* *What is the condition in question #4?*
3. Select several pairs to present their solution. Ask them to include an area model or a tree diagram that shows the possible outcomes.	*Can you prove your answers are correct? Can you show another approach to obtain the same answers?* *Which model seems to better represent what is happening in the problem? Why?* *Which model assists you the most in answering the questions? Why?*

Sample Space: {(Axle, good job), (Axle, bad job), (Sparky, good job), (Sparky, bad job)}

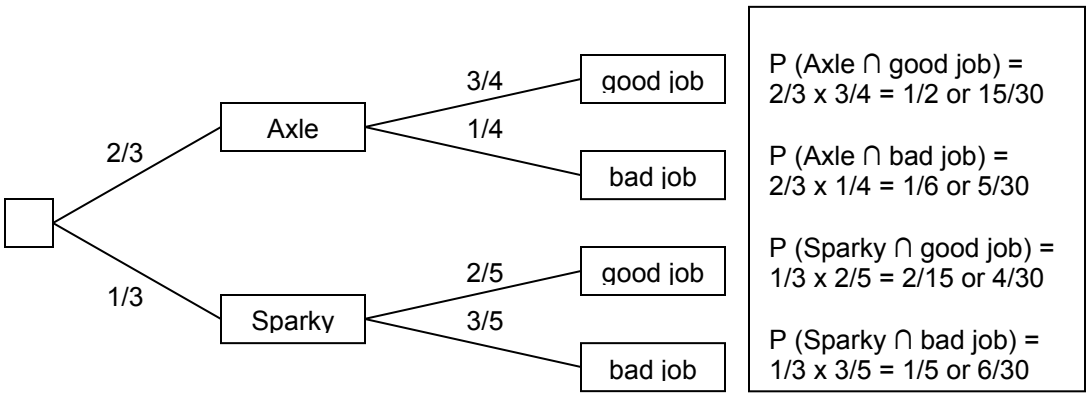
Area Model:



Area Model:



Tree Diagram:



Solution:

Use the formula for conditional probability which is $P(A \mid B) = P(A \cap B) \div P(B)$

a. P(good job) = P(Axle ∩ good job) + P(Sparky ∩ good job) = 15/30 + 4/30 = 19/30
b. Use the formula for conditional probability which is $P(A \mid B) = P(A \cap B) \div P(B)$
   P(Sparky | good job) = P(Sparky ∩ good job) ÷ P(good job) = (4/30 ÷ 19/30) = 4/19
c. P(good job | Axle) = P(good job ∩ Axle) ÷ P(Axle) = 1/2 ÷ 2/3 = 3/4
   (We didn't need to use the formula. P(good job | Axle) is given information. Axle does a good job 3 out of 4 times.)

Extension (additional questions):

d. What is the probability that a bad job will be done? (11/30)
e. What is the probability that Axle worked on your car if a good job is done? (15/19)
f. What is the probability that a bad job is done if Sparky worked on your car? (3/5)
g. What is the probability that a good job is done if Sparky worked on your car? (2/5)
h. What is the probability that Sparky worked on your car if a bad job is done? (6/11)
i. What is the probability that Axle worked on your car if a good job is done? (15/19)