Solving Probability Problems with Simulation

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Below is one problem, for which we can ask many questions. While we can answer the questions using the formula of the conditional probability:

P(A,B) = P(A) * P(B|A), we can also write code to estimate these probabilities computationally.

Example: Children in a Family

There is a family that has two "unknown" children.

If we assume:

- 1. Each child is equally likely to be a boy or a girl
- 2. The gender of the second child is independent of the gender of the first child

We can calculate the following probabilities for some possible events:

E1 = "no girls" (which is equivalent to two boys) --> P(E1) = 0.5 * 0.5 = 0.25

E2 = "one girl, one boy" (order doesn't matter) --> P(E2) = 0.25 + 0.25 = 0.5

E3 = "two girls" --> P(E3) = 0.5 * 0.5 = 0.25

Things become a bit more complicated, when we are interested in conditional events.

Question 1: What is the probability that "both children are girls" (B) conditional on the event that "the older child is a girl" (G)?

Use the **conditional probability** formula.

SOLUTION:

Question 2: What is the probability that "both children are girls" (B) conditional on the event that "at least one of the children is a girl" (L)?

SOLUTION:

Computational Solution for Example

We'll use code to simulate these scenarios and see what the results are.

```
In [ ]: import random
        def randomKid():
            return random.choice(["boy", "girl"])
        # data structure to store results
        results = {'bothGirls': 0.0, 'olderGirl': 0.0, 'eitherGirl': 0.0} # floa
        t to avoid integer division issues
        random.seed(0) # makes sure that we always generate the same sentence o
        f random values
        # run 10000 experiments and save the results
        for _ in range(10000): # is a variable without name, because we don't
         need to use it
            older = randomKid()
            younger = randomKid()
            if older == "girl":
                results["olderGirl"] += 1
            if older == "girl" and younger == "girl":
                results["bothGirls"] += 1
            if older == "girl" or younger == "girl":
                results["eitherGirl"] += 1
        print results
```

We can now try to calculate the two conditional probabilities we're interested:

```
In [ ]: print "P(both | older):", results['bothGirls']/results['olderGirl']
print "P(both | either): ", results['bothGirls']/results['eitherGirl']
In [ ]:
```