Lesson #2: Simple Simulations Involving TS in ABC Land

What's It All About?

This lesson involves the simulation of TS's behavior in ABC Land. A Pseudocode procedure based on the roll of a single die is provided for simulating one week of TS's behavior in ABC Land. Given this tool of thought, the probabilities considered in Exercise 1 will be reconsidered in Exercise 2.

Pseudocode Model for Simulating 1 Week's Behavior for TS in ABC Land

```
A    to simulate-one-week() do
1       cities = empty-list()
2       city = select-initial-city()
3       cities = add-to(city,cities)
4       repeat 4 times
5          city = select-city(city)
6          cities = add-to(city,cities)
7       print(cities)

B    to select-initial-city() do
1       face = roll-die()
2       if ( face is even ) then
3           return A
4       face = roll-die
5       if ( face is even ) then
6          return B
7       if ( face is odd ) then
8          return C

C    to select-city(city) do
1       if ( city is A ) then
2          face = roll-die()
3          if ( face is in {1,2} ) then
4             return A
5          if ( face is in {3,4} ) then
6             return B
7          if ( face is in {5,6} ) then
8             return C
9       if ( city is B ) then
10         face = roll-die()
11         if ( face is even ) then
12            return A
13         if ( face is odd ) then
14            return C
15      if ( city is C ) then
16         face = roll-die()
```

```
17          if ( face is in {1,2,3,4} ) then
18             return A
19          if ( face is in {5,6} ) then
20             return B
```

TS in ABC Land Exercise #2: Hand Simulation of Pseudocode

Please craft a document which presents **traces** of the following two simulation tasks.

1. First simulation task:

   Using as many of the outcomes from the given rolls of the die as are needed, taking them in order from left to right, simulate 1 week of TS behavior in ABC Land according to the given pseudocode description. In doing so, please **trace** the program by very carefully, methodically: (1) indicating the sequence of `instructions` executed (referencing each the instructions by juxtaposing a letter and a digit), and (2) maintaining the values of the variables as the assignments are performed. (We will get started together!)

   - Rolls of the die: `5 6 1 5 6 3 5 1 5 5 6 1 5 3 4 2 6 1 1 6 2 3 4 3 1 3 6 3 5 1 6 5 5 1 6 2 4`
   - Task: Hand simulate the pseudocode, and leave a **trace** as you do, by (1) Writing down the ID of a statement just before it is executed, and (2) writing down a construct of the form *VARIABLE=VALUE* for each new binding that is established, just after the assignment is performed. Finally, write down the tour, the sequence of city names of length 5, that results from the print statement.

2. Second simulation task:

   Using as many of the outcomes from the given rolls of the die as are needed, taking them in order from left to right, simulate 1 week of TS behavior in ABC Land according to the given pseudocode description.

   - Rolls of the die: `4 2 6 1 5 5 6 1 5 3 6 3 1 3 4 3 2 6 1 1 6 2 4 3 5 1 6 5 5 1 5 3 6 5 1 6 5`
   - Task: Write down the tour, the sequence of city names of length 5, that results from the print statement, leaving a **trace** of the simulation along the way. (In other words, do what you did in the case of the first simulation.)

TS in ABC Land Exercise #3: Some Probabilities Based on Simulation

Based on the given 20 tour simulation (see below), answer the following 15 questions. Although you are not being asked to turn your work in (this being an exercise), being the good student that you want to be, you should at least compose a document with your answer to each question, and an indication of the computation that was involved in obtaining your answer each question.

1. Monday (just to be sure we are clear on the interpretation)
   (a) What is the probability that TS will spend his Monday in A?
   (b) What is the probability that TS will spend his Monday in B?
   (c) What is the probability that TS will spend his Monday in C?

2. A $\rightarrow X$

   (a) Suppose that TS is in A on a given day. What is the probability that TS will spend the next day in A?

   (b) Suppose that TS is in A on a given day. What is the probability that TS will spend the next day in B?

   (c) Suppose that TS is in A on a given day. What is the probability that TS will spend the next day in C?

3. B $\rightarrow X$

   (a) Suppose that TS is in B on a given day. What is the probability that TS will spend the next day in A?

   (b) Suppose that TS is in B on a given day. What is the probability that TS will spend the next day in B?

   (c) Suppose that TS is in B on a given day. What is the probability that TS will spend the next day in C?

4. C $\rightarrow X$

   (a) Suppose that TS is in C on a given day. What is the probability that TS will spend the next day in A?

   (b) Suppose that TS is in C on a given day. What is the probability that TS will spend the next day in B?

   (c) Suppose that TS is in C on a given day. What is the probability that TS will spend the next day in C?

5. Tuesday

   (a) Given all that you know about TS, what is the probability that he will be in A on Tuesday?

   (b) Given all that you know about TS, what is the probability that he will be in B on Tuesday?

   (c) Given all that you know about TS, what is the probability that he will be in C on Tuesday?

Results of the 20 tour simulation

```
Simulating 20 weeks of behavior for TS in ABC Land ...
tour = < C A C A B >
tour = < C A B C A >
tour = < A C A C A >
tour = < C A C A B >
tour = < A B C A B >
tour = < A B A A A >
tour = < A C A C A >
tour = < B C A C B >
tour = < C B A C A >
tour = < A C A C A >
tour = < A A B A C >
tour = < A C A C B >
tour = < C A B C A >
tour = < A A B C A >
tour = < A A A C B >
tour = < C A C A A >
tour = < A A B C B >
tour = < B C A C B >
tour = < A C B A A >
tour = < A C B A A >
```