INTELLIGENT SAMPLING USING EQUIVALENCE PARTITIONING

RANDALL W. RICE, CTAL (FULL), CTFL-AT, CMT
WWW.RICECONSULTING.COM
12/17/15

© 2015, Rice Consulting Services, Inc.

RICECONSULTING

SLIDES AND RECORDING

- **Will be available later today at**
  - http://randallrice.blogspot.com
  - Facebook - https://www.facebook.com/Randy-Rices-Software-Testing-Page-205723278494/
  - http://www.riceconsulting.com

RICECONSULTING

2

THE PROBLEM

- **Many testers complain they don't have enough time to perform and evaluate the tests they need to cover.**

- **However, even if you had unlimited time, you still wouldn't have enough time to completely test anything of significant complexity.**

3

POSSIBLE SOLUTIONS

- **Risk-based Testing**
  - However, there are shortcomings to this approach.
    - What is everything is "high" risk?
    - It can be a convenient excuse for not testing enough.
    - We can be fooled by inaccurate risk assessments.
- **Combinatorial Testing**
  - Also issues with this approach.
    - Examples – Pairwise, Orthogonal Arrays, etc.
    - However, these tools and methods are maturing.
    - Plus, research shows this to be fairly effective.

4

POSSIBLE SOLUTIONS (2)

- **"Reconciled" Decision Tables**
  - OK, but some of the illogical test cases that get dropped may actually be good negative tests.
- **Test Automation**
  - Harder than it seems at first
    - You have to create and maintain the tests, which takes time.
    - Not everything can or should be automated.
- **Intelligent Sampling based on Equivalence Partitioning**
  - Not perfect, either, but it could be a very solid approach.
    - It's only as reliable as your knowledge of the behavior of a class.

RICE CONSULTING

5

MORE TESTS ARE NOT NECESSARILY BETTER

- **As I have said over the years: "Test cases are like kids. The more you have, the more you have to keep up with."**

RICE CONSULTING

6

REAL WORLD EXAMPLE

- **At a client we were developing a course for using orthogonal arrays to optimize testing.**
- **We were using one of their examples for stock trading.**
- **The thing that made the number of test cases high was "broker."**

RICE CONSULTING

7

REAL WORLD EXAMPLE

- Collateral Type = Futures, Derivatives
- Need by Date = Correct, Missing, Wrong (Could be almost unlimited)
- Collateralized Amount = Correct, Missing, Wrong (Could be almost unlimited)
- Fund = Fund A, Fund B
- Broker = 16 choices for banking institution
- Client Type = New, Existing, Individual, Institutional

RICE CONSULTING

8

TOTAL NUMBER OF TEST CASES

Factors	Levels
Fund	2
Collateral Type	2
Broker	16
Client Type	4
Collateralized Amount	3
Need by Date	3

Total Number of Scenarios = **2 x 2 x 16 x 4 x 3 x 3 = 2,304***

* This number does not include Alternate or Exception Courses.

RICE CONSULTING

9

THEN, SOMEONE NOTICED...

- **Although we had 16 Broker Types listed, for our purposes they could be classified as 4 unique types:**
  - Banks
  - Insurance companies
  - Stock brokerages
  - No broker

RICE CONSULTING

10

THIS CHANGED THE PICTURE

Conditions	Options
Fund	2
Collateral Type	2
Broker	**4**
Client Type	4
Collateralized Amount	3
Need by Date	3

Total Number of Scenarios = **2 x 2 x 4 x 4 x 3 x 3 = 576**

The previous count was **2,304 – a 75% Decrease in test cases!**

RICE CONSULTING

11

TO PUT THIS IN PERSPECTIVE

- **Let's say it takes:**
  - 10 minutes to document a test case
    - Could be greatly less if we used a combinatorial tool.
  - 15 minutes to perform, evaluate and document the case on average.
  - 5 minutes to report a defect.
    - We'll assume a very conservative 10% defect rate.
  - 15 minutes to re-test a single fix.

RICE CONSULTING

12

TO PUT THIS IN PERSPECTIVE

- **So, for 2,304 test cases, we are looking at:**
  - 960 hours to design, perform and evaluate all cases just one time!
  - 19.2 hours to report defects.
  - 57.6 hours to retest all defects.
  - Oh, and to perform a regression test?
    - That depends on a lot of things, but if we do a full regression test, 960 hours, if manually performed.
  - Total test time for the 1st cycle, defect identification, reporting and re-testing, plus regression testing = **1,996.8** hours.
    - That is one person-year!

RICECONSULTING

13

WITH EQUIVALENCE PARTITIONING

- **For 576 test cases, we are looking at:**
  - 240 hours to design, perform and evaluate all cases just one time!
  - 4.6 hours to report defects.
  - 10 hours to retest all defects.
  - Oh, and to perform a regression test?
    - That depends on a lot of things, but if we do a full regression test, 240 hours, if manually performed.
  - Total test time for the 1st cycle, defect identification, reporting and re-testing, plus regression testing = **494.6** hours.
    - Still a lot of time, but ¼ of the previous time!

RICECONSULTING

14

WHAT ABOUT AUTOMATION?

- **Yes, you could *perhaps* reduce the total time by creating a data-driven test for all 2,304 test cases.**
- **However,**
  - You still have to create the automation.
  - In some cases, you have to acquire the tool and learn it.
  - You may have script stability problems
  - You still have to create an oracle
- **The upside of automation is that the numbers of test cases become less important in run times.**
  - However, the test case count is still very important where test case maintenance is concerned.

RICECONSULTING

15

LET'S EXPLORE MORE ABOUT EQUIVALENCE PARTITIONING

- **EP can be seen in many ways:**
  - Based on input conditions, types, etc.
  - Based on output conditions
  - In single or multiple dimensions
  - Based on configurations
- **We'll look at each of these in more detail.**

RICECONSULTING

16

FIRST, A WORD OF WARNING

- **Your ability to define equivalence partitions (or classes) depends on your knowledge of how a particular function is performed, or how a certain condition is handled.**
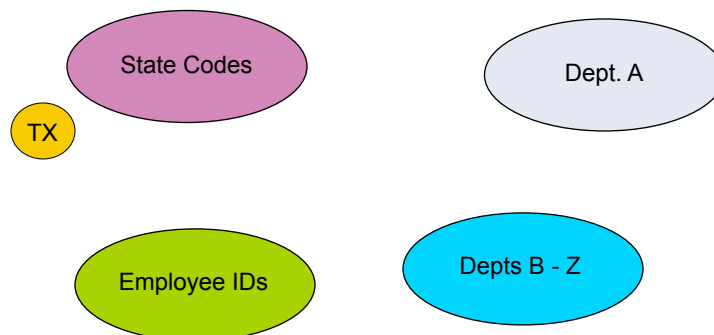

RICECONSULTING

17

EXAMPLE

- **Let's say that you are testing an HR system.**

State Codes

TX

Dept. A

Employee IDs

Depts B - Z

RICECONSULTING

18

EP BASED ON INPUTS, CONDITIONS, TYPES

- **Let's say that we are testing an airline loyalty program that has 4 levels:**
  - Regular (less than 25 segments flown in the calendar year)
  - Gold (=>25 but < 50 segments flown in the calendar year)
  - Platinum (=>50 but < 100 segments flown in the calendar year)
  - Executive Platinum (100 or greater segments flown in the calendar year)
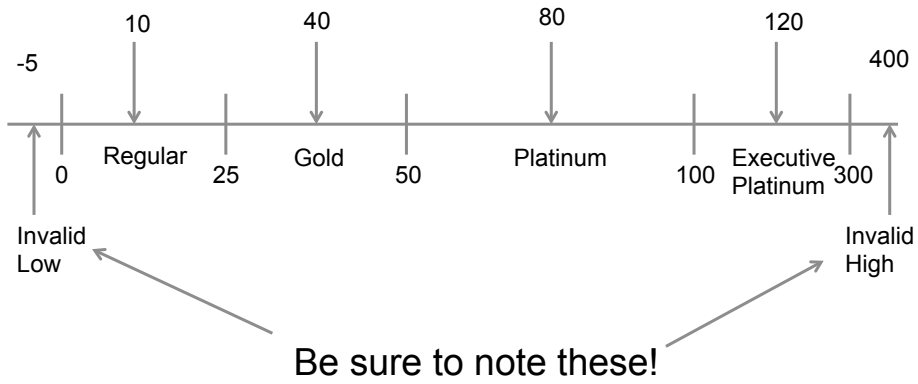
RICECONSULTING

19

OTHER RULES

- **There are other rules, such as:**
  - Negative segments are invalid
  - Zero segments are possible
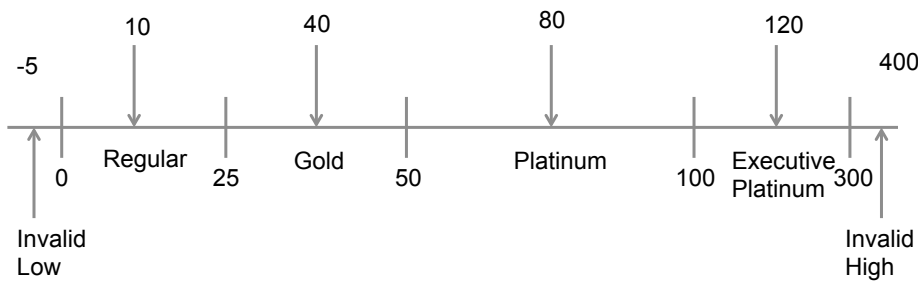 - Any value over 300 segments is considered invalid

RICECONSULTING

20

CLASSIC, SINGLE DIMENSIONAL EP

Be sure to note these!

21

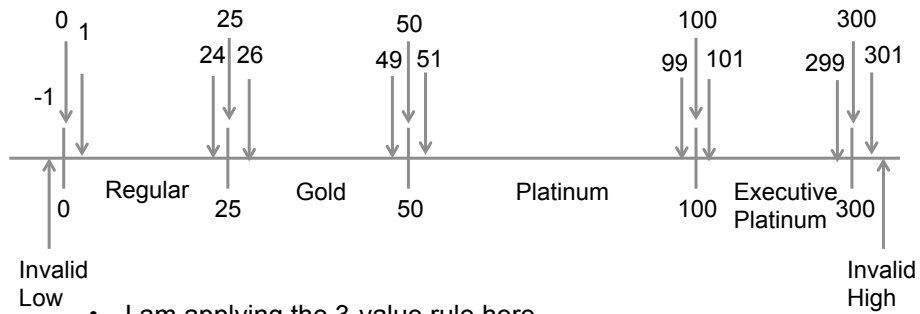## THESE VALUES WOULD BE CONTAINED IN THE CLASSES

22

HOWEVER, THE STRONGER CASES ARE AT THE BOUNDARIES

```
        0                 25                50                    100          300
          1             24  26          49  51                99  101     299  301
       -1

              Regular               Gold            Platinum       Executive
                                                                   Platinum
          0                   25              50              100          300

    Invalid                                                              Invalid
    Low                                                                  High
```

- I am applying the 3-value rule here.
- The important thing to see is that the classes led us to the boundary values. That's why we do EP first.
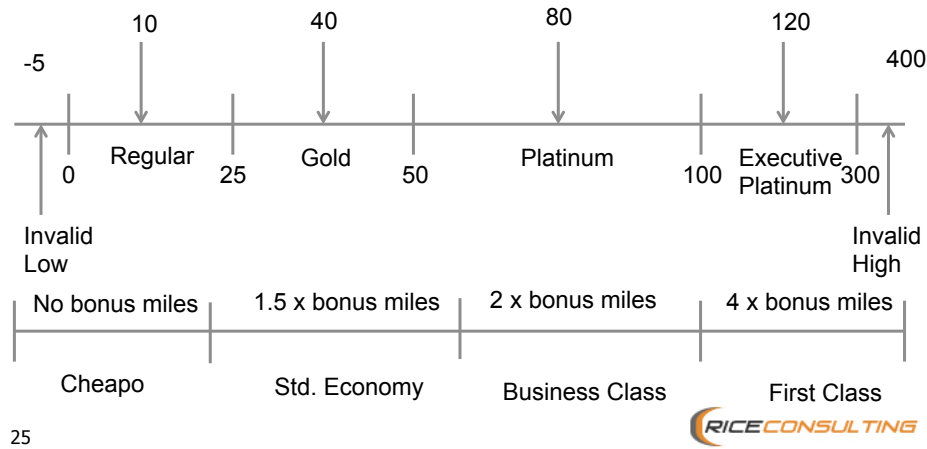- BVA is related to EP, but not the same.

RICE CONSULTING

23

NOW, LET'S EXTEND THE RULE

- **Let's say that depending on the fare you pay, you get bonus miles in your account.**

  - Super cheap fare = 0 bonus miles
  - Standard economy = 1.5 x bonus miles
  - Business class = 2 x bonus miles
  - First class = 4 x bonus miles

RICE CONSULTING

24

TWO DIMENSIONAL EP

25

TO GET 100% EP COVERAGE

- **You need test cases that cover all of these:**
  - Less than 0 segments (Invalid low)
  - Greater than or equal to 0 and less than 25 segments (e.g. 10) (Regular)
  - Greater than or equal to 25 and less than 50 segments (e.g. 40) (Gold)
  - Greater than or equal to 50 and less than 100 segments (e.g. 80) (Platinum)
  - Greater than or equal to 100 and less than 300 segments (e.g. 120) (Exec. Platinum)
  - Greater than 300 segments (Invalid high)
  - Cheapo fare
  - Standard economy fare
  - Business class fare
  - First class fare

26

YOU CAN COMBINE CLASS VALUES

Case	Segments	Fare	Exp Result
1	-10	Std. Economy	Invalid
2	5	Cheapo	Regular, no bonus miles
3	40	Business class	Gold, 2 x bonus miles
4	80	First class	Platinum, 4x bonus miles
5	120	Std. Economy	Platinum 1.5 bonus miles
6	400	Std. Economy	Invalid

In this example, we need 6 test cases to cover all values in both sets of classes
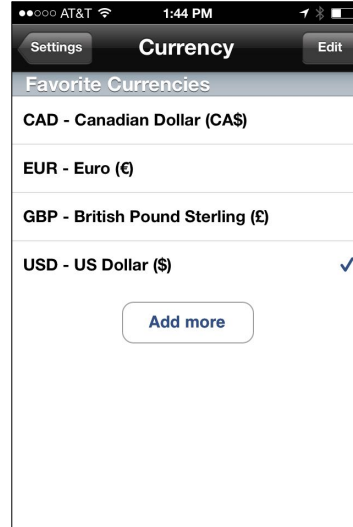
27

ANOTHER EXAMPLE

Equivalence Partitions

Note: It is possible to have multiple equivalence partitions.

28

14

ANOTHER EXAMPLE

●●○○○ AT&T 🗢	1:44 PM	⌁ ⅄ ▭
Settings	**Currency**	Edit

Favorite Currencies

CAD - Canadian Dollar (CA$)

EUR - Euro (€)

GBP - British Pound Sterling (£)

USD - US Dollar ($)   ✓

Add more

RICECONSULTING

29

EP BASED ON CONFIGURATIONS

- **Let's say we are testing mobile devices with the following configurations:**
  - iOS (8, 9.0, 9.1, 9.2)
  - Android (4.4, 5.0, 5.1, 6.0)
  - Memory (8 GB, 16 GB, 32 GB, 64 GB)
- **You would have**
  - 8 classes of O/S types
  - 4 classes of memory
- **You could optimize and have 8 configurations with O/S being the driver.**

RICECONSULTING

30

SUMMARY

- **EP is often overlooked as a way to optimize testing.**
  - However, it is a solid technique and doesn't have as many downsides as other techniques such as pairwise and risk-based techniques (although those techniques still have value.)
- **EP can be applied in a variety of ways ranging from simple to complex.**
- **You must understand the actual rules applied in a certain problem domain.**
  - Not the rules as perceived or assumed.
  - Many times, these rules are not documented.
- **It is good to combine techniques to balance the downsides of each.**
  - Of course, you only have so much time and so many resources.

RICECONSULTING

31

BIO - RANDALL W. RICE

- **Over 34 years experience in building and testing information systems in a variety of industries and technical environments**
- **ISTQB Certified Tester – Foundation level (CTFL), Foundation Level Agile Tester (CTFL-AT) and Advanced Level (CTAL) Full**
- **Director, American Software Testing Qualification Board (ASTQB) since 2006.**
- **Chairperson, 1995 - 2000 QAI's annual software testing conference**
- **Co-author with William E. Perry, *Surviving the Top Ten Challenges of Software Testing* and *Testing Dirty Systems***
- **Principal Consultant and Trainer, Rice Consulting Services, Inc.**

RICECONSULTING

32

CONTACT INFORMATION

Randall W. Rice, CTAL (Full), CTFL-AT, CMT

Rice Consulting Services, Inc.

P.O. Box 892003

Oklahoma City, OK 73189

Ph: 405-691-8075

Fax: 405-691-1441

Web site: www.riceconsulting.com

e-mail: rrice@riceconsulting.com

33