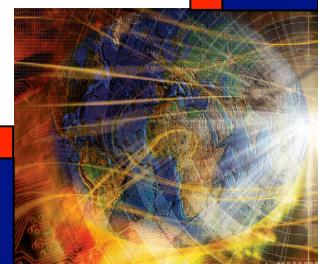


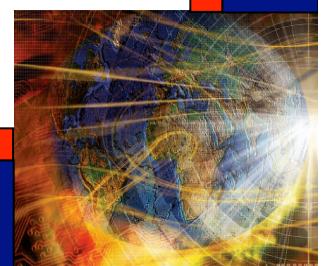
# Chapter 8

## Retrospective on Functional Testing



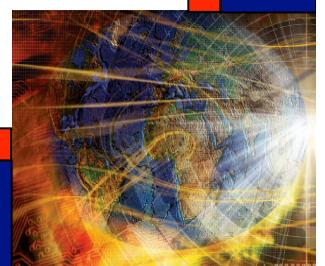
# Retrospective on Functional Testing

- **Test case development effort**
- **Test case effectiveness**
- **Test method selection guidelines**
- **Case study**

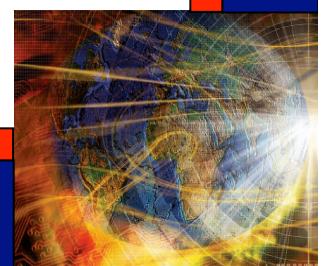
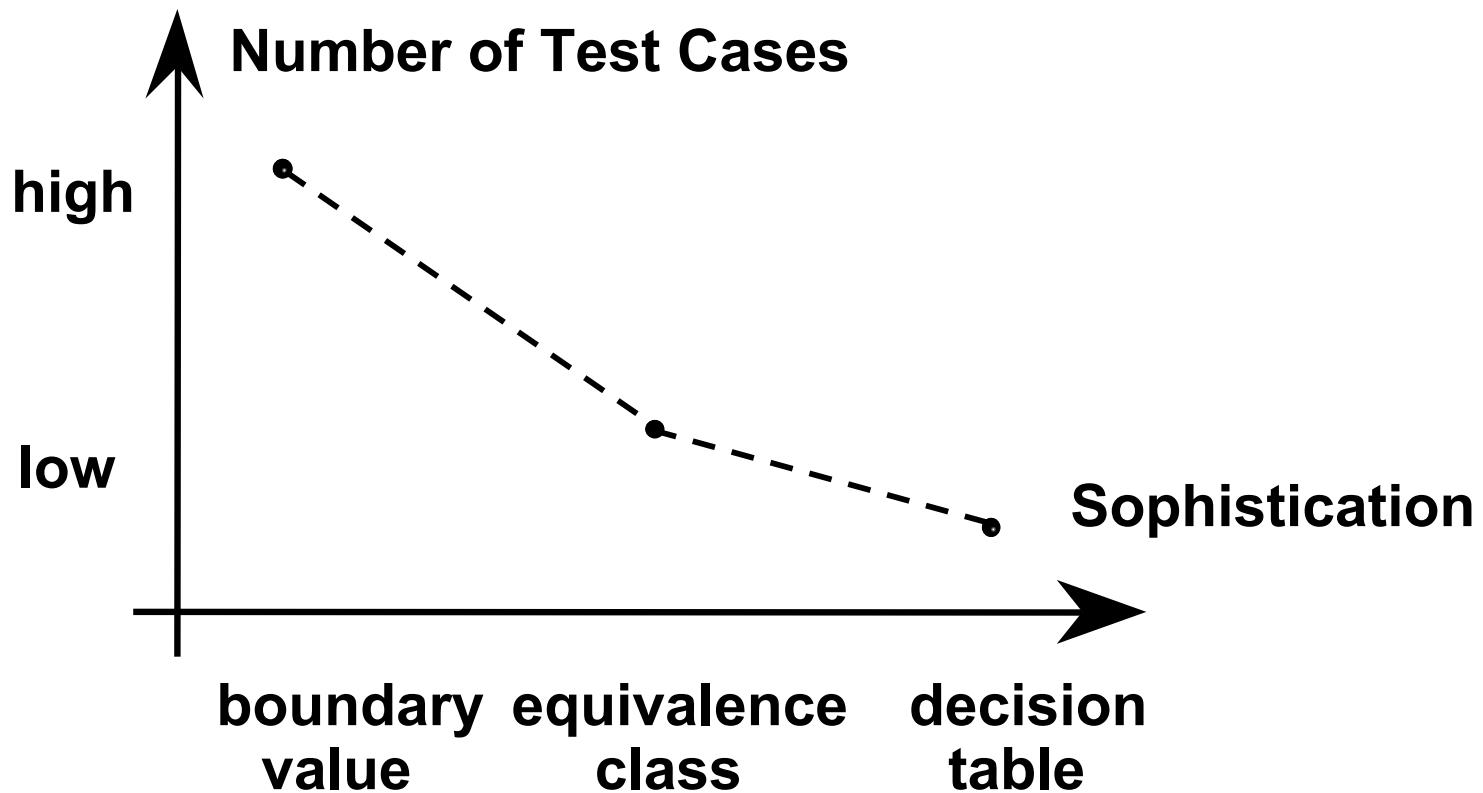


# Test Case Development Effort

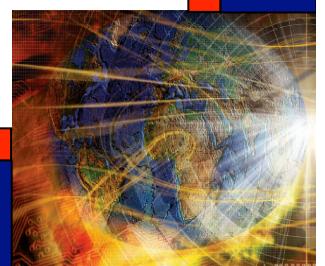
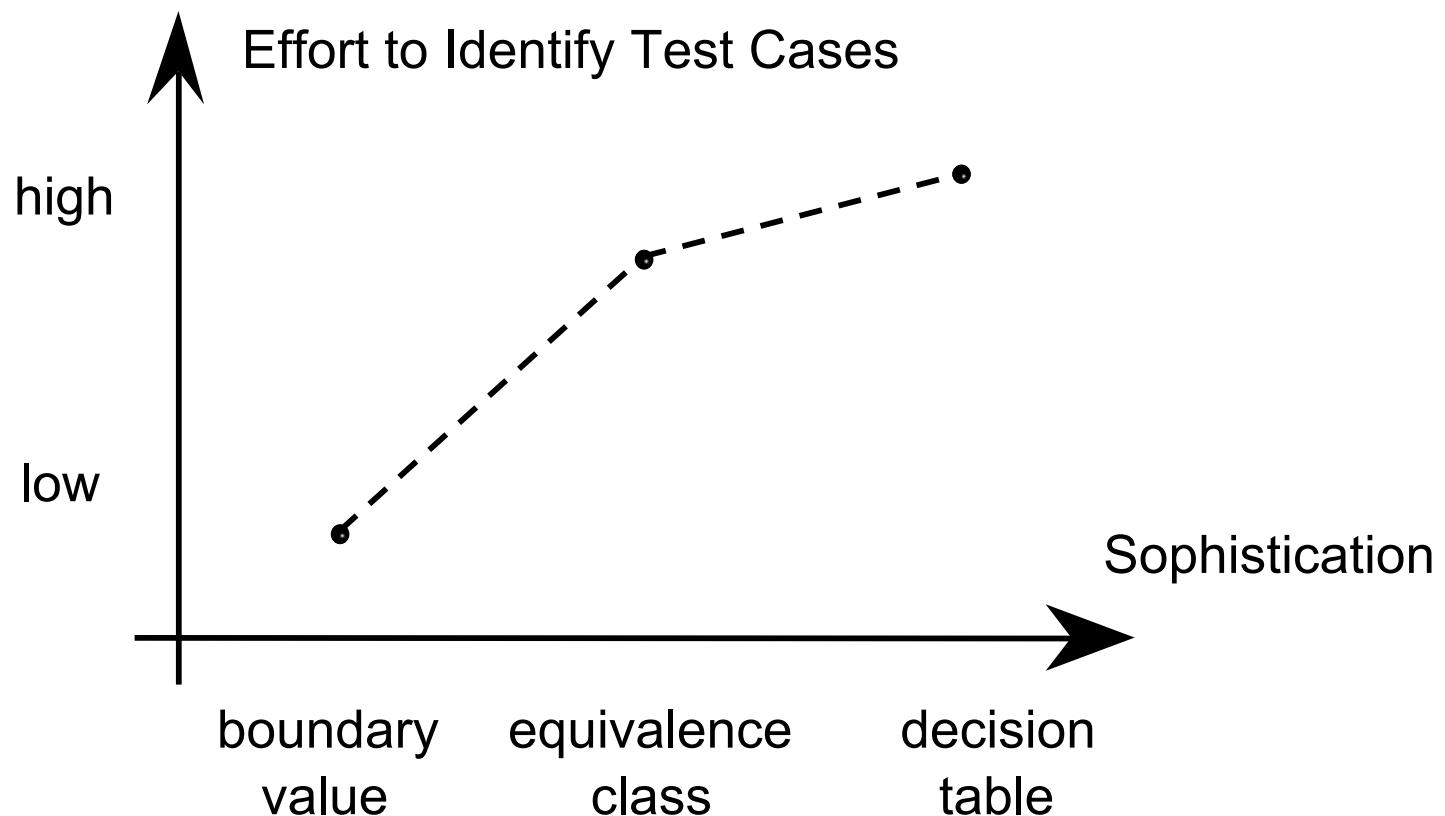
- As with so many things in life,  
“You get out of it what you put into it.” --Dad
- Boundary value: almost mechanical
- Equivalence class: effort to identify classes
- Decision table: still more effort



# Numbers of Test Cases

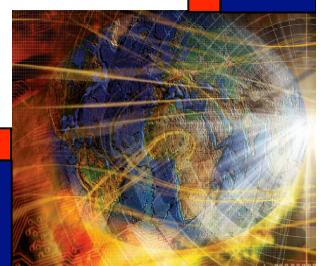


# Test Case Development Effort



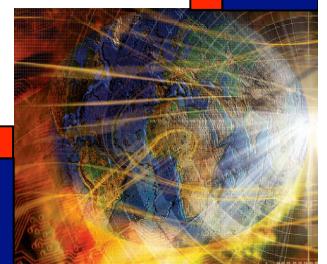
# Test Case Effectiveness

- True trade-off between development effort and number of test cases.
- Vulnerabilities
  - Boundary value testing has gaps and redundancies, and many test cases.
  - Equivalence class testing eliminates the gaps and redundancies, but cannot deal with dependencies among variables.
  - Decision table testing extends equivalence class testing by dealing with dependencies, and supports algebraic reduction of test cases.



# Appropriate Choices of Test Methods

c1. variables (P, physical, L, logical)	P	P	P	P	P	L	L	L	L	L
c2. independent variables?	Y	Y	Y	Y	N	Y	Y	Y	Y	N
c3. single fault assumption?	Y	Y	N	N	-	Y	Y	N	N	-
c4. exception handling?	Y	N	Y	N	-	Y	N	Y	N	-
a1. boundary value analysis (BVA)		x								
a2. robustness BVA	x									
a3. worst case BVA										
a4. robust worst case BVA										
a5. weak normal equiv. class		x					x			
a6. weak robust equiv. class	x					x				
a7. strong normal equiv. class			x					x		
a8. strong robust equiv. class			x				x			
a9. decision table				x					x	

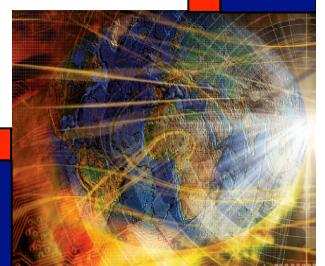


# Case Study

A hypothetical Insurance Premium Program computes the semi-annual car insurance premium based on two parameters: the policy holder's age and driving record:

$$\text{Premium} = \text{BaseRate} * \text{ageMultiplier} - \text{safeDrivingReduction}$$

The **ageMultiplier** is a function of the policy holder's age, and the safe driving reduction is given when the current points (assigned by traffic courts for moving violations) on the policy holder's driver's license are below an age-related cutoff. Policies are written for drivers in the age range of 16 to 100. Once a policy holder has 12 points, his/her driver's license is suspended (hence there is no need for insurance). The **BaseRate** changes from time to time; for this example, it is \$500 for a semi-annual premium.



# Insurance Premium Program Data

<i>Age Range</i>	<i>Age Multiplier</i>	<i>Points Cutoff</i>	<i>Safe Driving Reduction</i>
16<= age < 25	2.8	1	50
25<= age < 35	1.8	3	50
35<= age < 45	1.0	5	100
45<= age < 60	0.8	7	150
60<= age <= 100	1.5	5	200

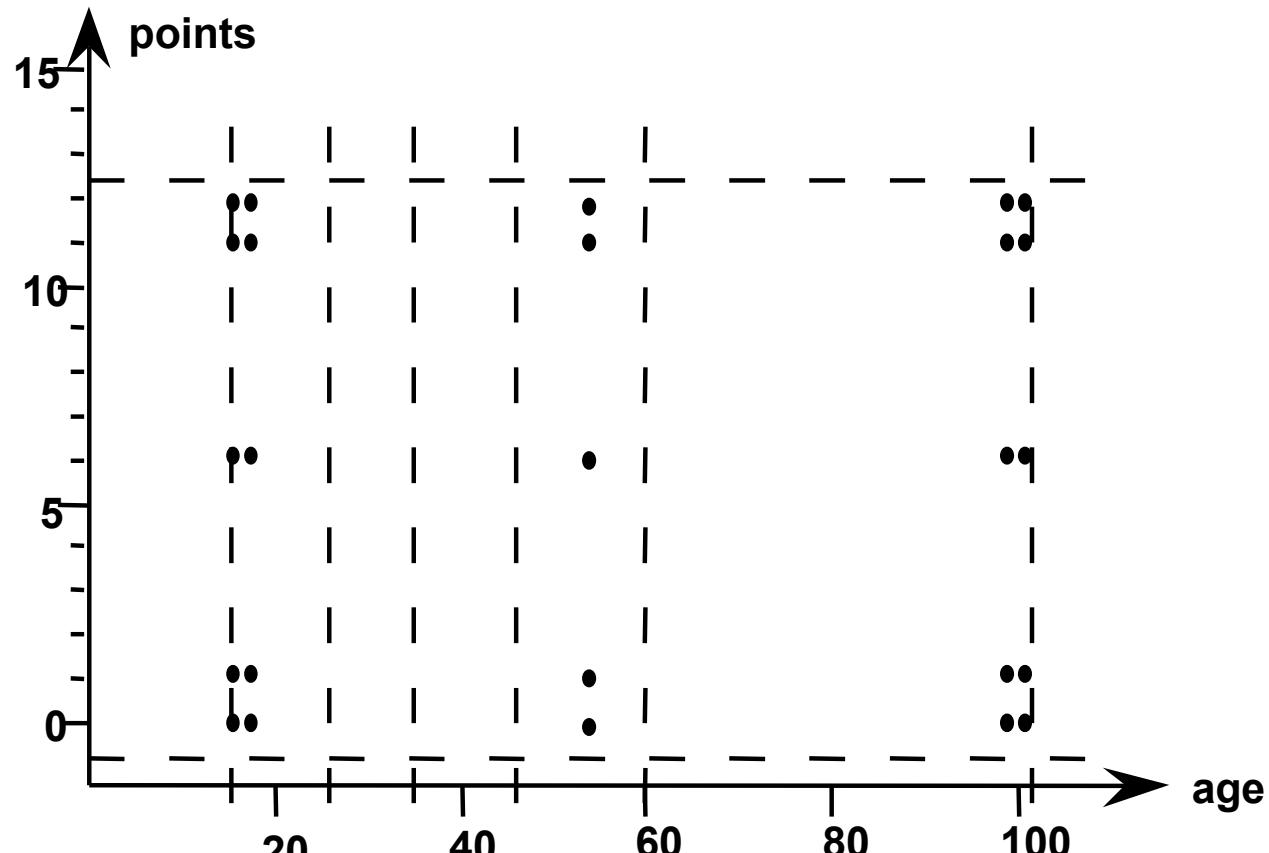


# Insurance Premium Program Calculations, Test Method Selection

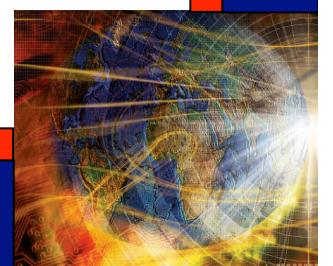
- **Premium = BaseRate\*ageMultiplier – safeDrivingReduction**
- **ageMultiplier = F1(age)** [from table]
- **safeDrivingReduction = F2(age, points)** [from table]
- **age and safeDrivingReduction are physical variables, with a dependency in F2.**
- **Boundary values for age: 16, 17, 54, 99, 100**
- **Boundary values for safeDrivingReduction: 0, 1, 6, 11, 12**
- **Robust values for age and safeDrivingReduction are not allowed by business rules.**
- **Worst case BVA yields 25 test cases, and many gaps, some redundancy. Need something better.**



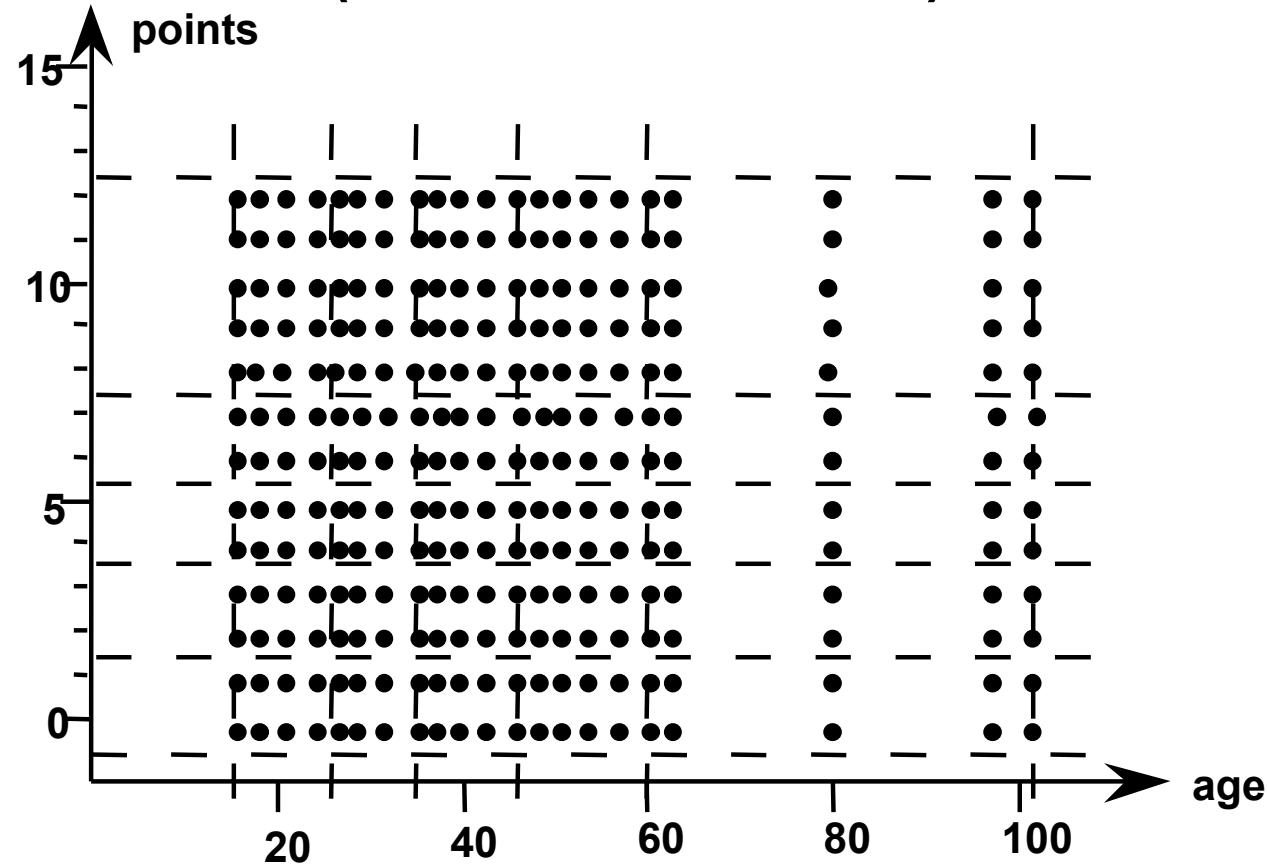
# Graph of Boundary Value Test Cases



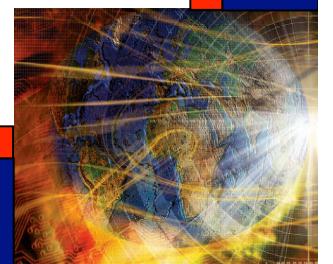
Severe gaps!



# Graph of Boundary Value Test Cases (refined boundaries)

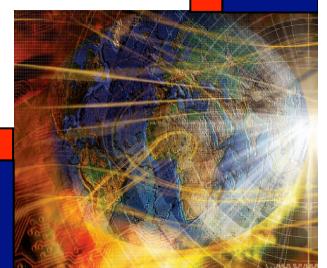


**Severe redundancy!**

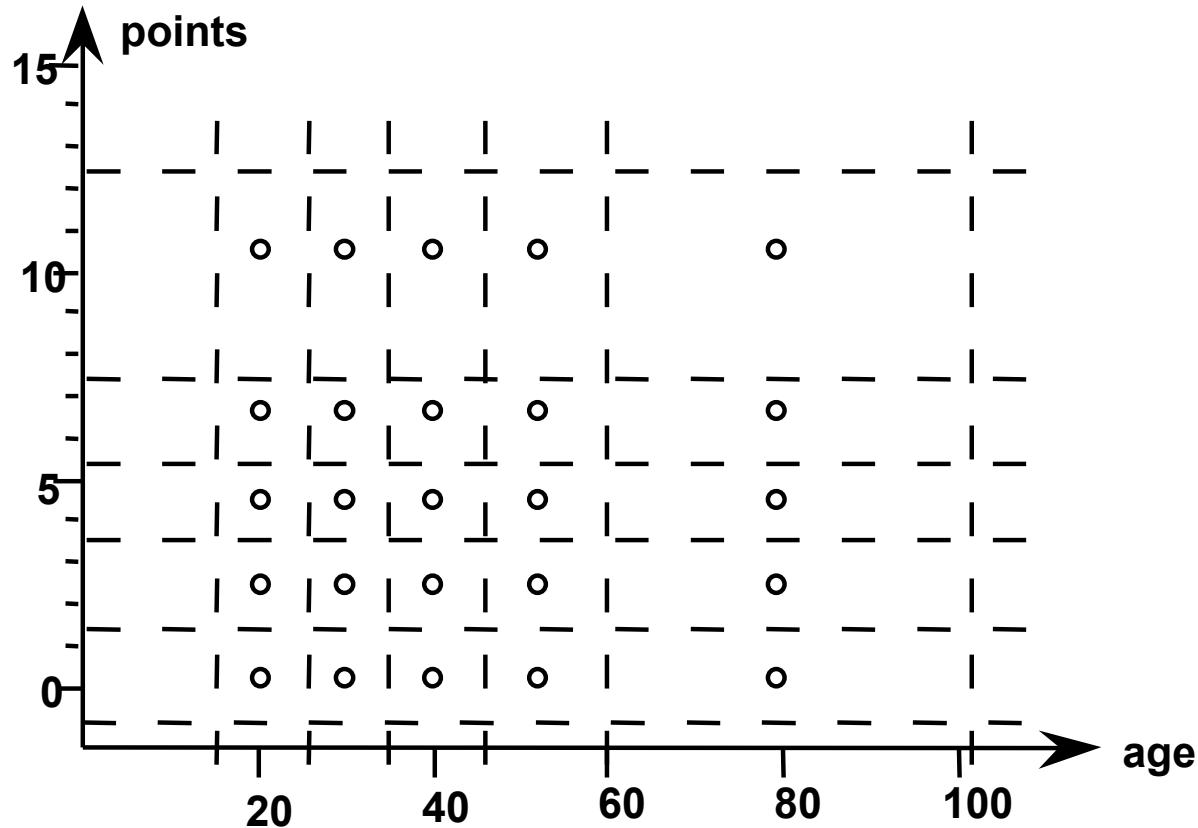


# Insurance Premium Program Test Method Selection

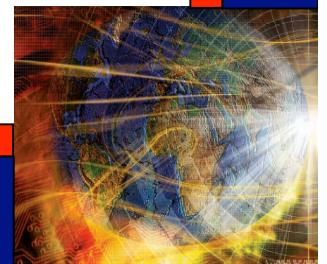
- age has ranges that receive similar treatment. equivalence class testing is indicated.
  - Age ranges per the data table
- The points cutoff is also a range, further indication for equivalence class testing.
  - Points {0, 1}
  - Points {2, 3}
  - Points {4, 5}
  - Points {6, 7}
  - Points {8, 9, 10, 11, 12}



# Insurance Premium Program Strong Normal Equivalence Class Test Cases



Still a lot of redundancy, try decision tables.

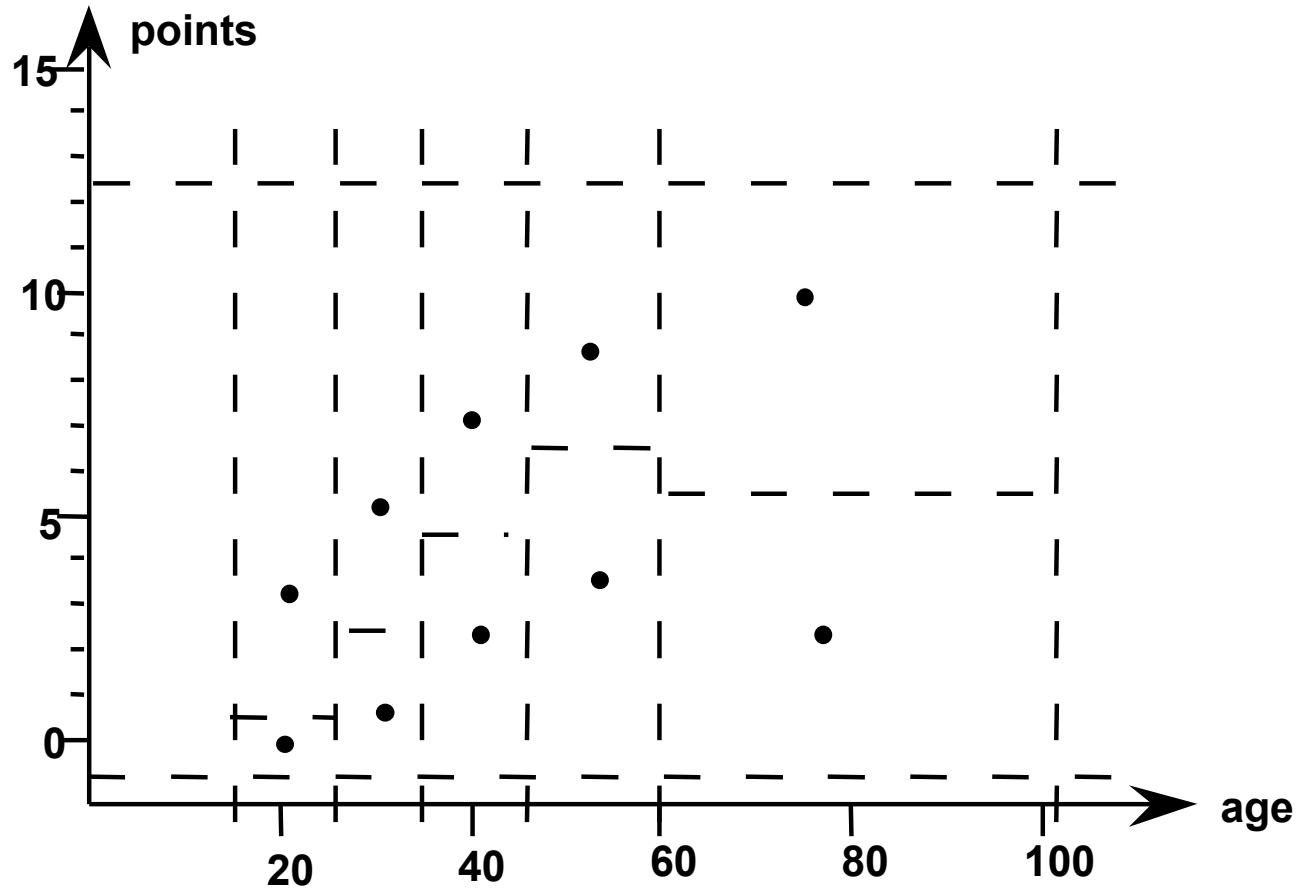


# Insurance Premium Program Decision Table Test Cases

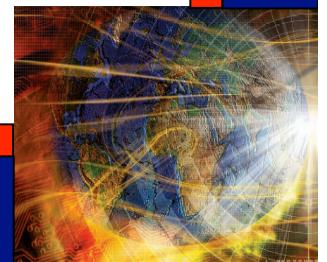
c1. age is	16-25		25-35		35-45		45-60		60-100	
c2. points	0	1-12	0-2	3-13	0-4	5-12	0-6	7-12	0-4	5-12
a1. age multiplier	2.8	2.8	1.8	1.8	1.8	1.8	0.8	0.8	1.5	1.5
a2. safeDriving	50	--	50	--	100	--	150	--	200	--



# Insurance Premium Program Decision Table Test Cases

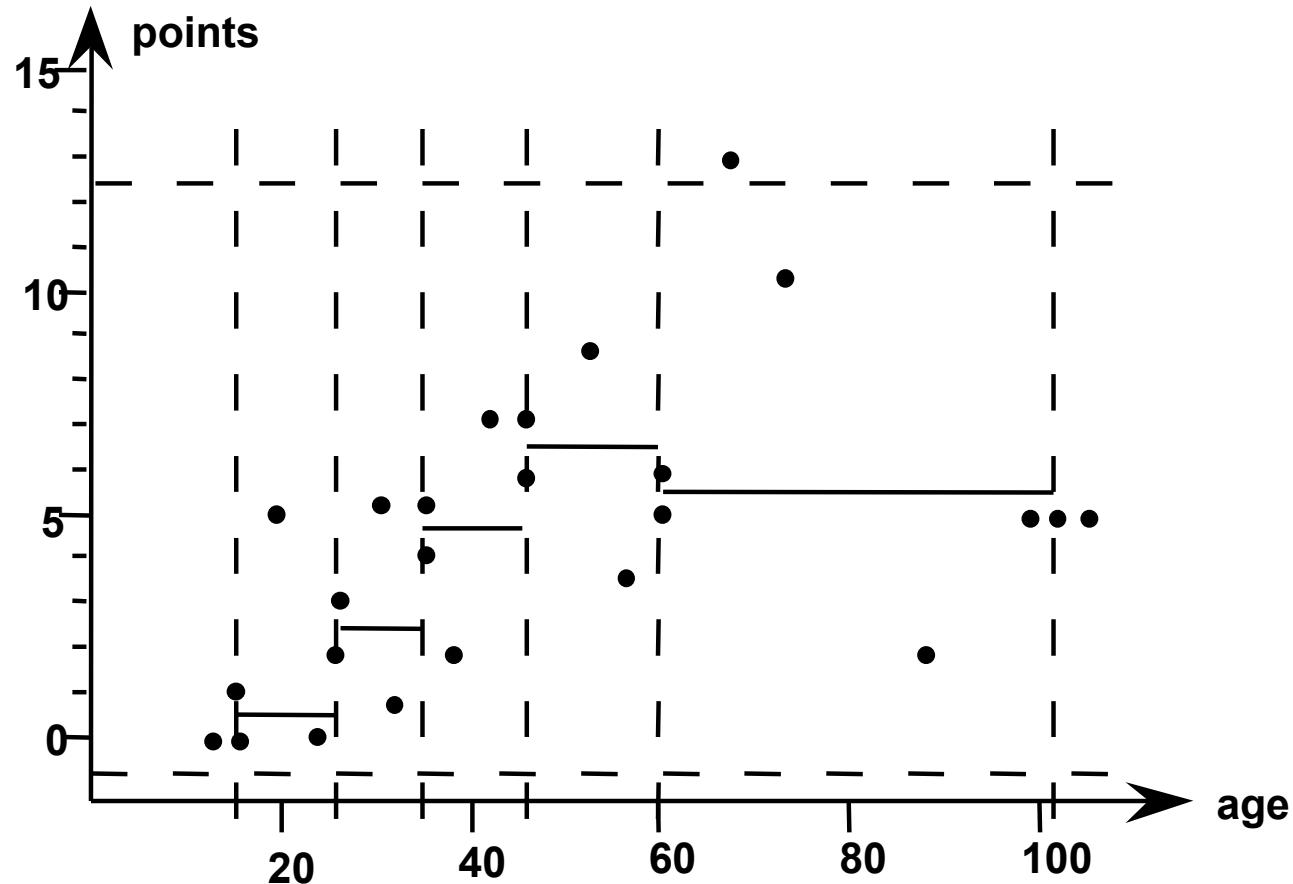


What about age range endpoints?



# Insurance Premium Program Test Cases

(Decision table with boundary values hybrid)



Ahhhh, at last!



# Wrap Up

- **The inherent nature of the program being tested should dictate the test method.**
  - The decision table “expert system” (slide 7) recommendation is just a start.
  - Applications are seldom “chemically pure”.
- **Hybrid combinations of test methods can be very useful.**
- **Good judgment, based on insight, is a sign of a craftsman.**

