Vacation Rule Modeling Challenge Solution 1

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A Solution

Since the number of days depends only on the age of the employee and their years of service, one way to represent the logic is as single decision table with all of the relevant conditions expressed as rule columns like this:

Conditions	0	1	2	3	4	5	6	7
Age		< 18	>= 60	18..59	>= 60	18..59	45..59	18..44
Service		-	-	>= 30	>= 30	15..29	< 30	< 15
Actions	◄							
Post Message(s)	☒	☒	☒	☒	☒	☒		
Base Days	22							
Extra Days		5	5	5	3	2	2	0

Rule Statements ⊠

Ref	Text
0	Base: Every employee receives at least 22 days
	Extra days:
1	1A. Only employees younger than 18 receive 5 extra days
2	1B. Only employees at least 60 receive 5 extra days
3	1C. Only employees with at least 30 years of service receive 5 extra days (if they didn't already get 5 days because of their age)
4	2. Employees with at least 30 years of service and [also employees of] age 60 or more receive 3 extra days on top of other days
5	3A. If an employee has at least 15 but less than 30 years of service 2 extra days are given. They cannot be combined with the 5 extra days.
6	3B. These 2 days are also provided for employees age 45 or more. They cannot be combined with the 5 extra days.
7	Employees do not get extra days when years of service is less than 15 and age is 18 - 44

The Details (How did we get there?)

It is useful to see the design process that lead to this decision table (Just like Jacob Feldman, I made several silly mistakes along the way. Notably interpreting the specification incorrectly - in particular the significance of the word "also" in rule 3 - and using > for "at least" when I should have used >=). Fortunately the integrity tools within Corticon helped catch these.

Before we rush to create a decision model it's important to be clear on the intent of the rules. And as we know this can often be different from what is stated. The same spec may even be interpreted differently by different readers as you will notice if you compare the solutions. The message is clear – don't try to write logic specs in English – you will most likely fail. Use decision tables from the outset.

Rule 1. *Only employees younger than 18 or at least 60, or with at least 30 years of service receive 5 extra days 1*

What if you are over 60 with at least 30 years of service – do you get 5 days for being over 60 and another 5 days for having at least 30 years of service (as in the first decision table)?

Conditions	1	2	3
Age	< 18	>= 60	-
Service	-	-	>= 30
Actions			
Post Message(s)			
Extra Days	5	5	5

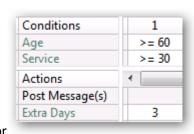| Conditions	1	2	3
Age	< 18	>= 60	18..59
Service	-	-	>= 30
Actions			
Post Message(s)			
Extra Days	5	5	5

or

We'll assume you only get the 5 days once (as in the second decision table)

Rule 2. *Employees with at least 30 years of service and also employees of age 60 or more receive 3 extra days on top of other days*

Does this mean you get 3 extra days for having over 30 years of service and another 3 days for being over 60? Or just 3 days if you meet both criteria? Or just 3 days if you meet either criteria?

Conditions	1	2
Age	>= 60	-
Service	-	>= 30
Actions		
Post Mess...		
Extra Days	3	3

Conditions	1
Age	>= 60
Service	>= 30
Actions	
Post Message(s)	
Extra Days	3

Conditions	1	2
Age	>= 60	< 60
Service	< 30	>= 30
Actions		
Post Mess...		
Extra Days	3	3

or   or

We'll assume you must meet both criteria to get the 3 days just once (the second decision table).

Rule 3. *If an employee has at least 15 but less than 30 years of service 2 extra days are given. These 2 days are **also** provided for employees age 45 or more. They cannot be combined with the 5 extra days.*

Can an employee get the 2 days twice? Once for years of service and once for being 45 or more? It appears so.
The word "also" is in bold because it's critical to the meaning of this rule. Without it there would probably be one rule with two conditions. But "also" makes it into two rules, one using age and one using years of

Conditions	1	2	3	4	5
Age	< 18	>= 60	18..59	-	>= 45
Service	-	-	>= 30	15..29	-
Actions					
Post Message(s)					
Extra Days	5	5	5	2	2

service. With the implication that an employee can get two helpings of the 2 days (if they didn't already get the 5 days) Also, if an employee happens to qualify for 2 days under this rule and 5 days under rule 1 do they get 5 or 2? We'll assume they get 5.

Ambiguity

Initially the Corticon ambiguity checker will flag these rule pairs (since as modeled the employee could get both the 5 and the 2 days). If the spec had allowed both 5 and 2 days then we wouldn't need to change these rules.

Conditions	1	2	3	4	5
Age	< 18	>= 60	18..59	-	>= 45
Service	-	-	>= 30	15..29	-
Actions	◄				
Post Message(s)					
Extra Days	5	5	5	2	2

Conditions	1	2	3	4	5
Age	< 18	>= 60	18..59	-	>= 45
Service	-	-	>= 30	15..29	-
Actions	◄				
Post Message(s)					
Extra Days	5	5	5	2	2

Conditions	1	2	3	4	5
Age	< 18	>= 60	18..59	-	>= 45
Service	-	-	>= 30	15..29	-
Actions	◄				
Post Message(s)					
Extra Days	5	5	5	2	2

Conditions	1	2	3	4	5
Age	< 18	>= 60	18..59	-	>= 45
Service	-	-	>= 30	15..29	-
Actions	◄				
Post Message(s)					
Extra Days	5	5	5	2	2

However, in order to comply with the spec ("*They cannot be combined with the 5 extra days* ") there are a couple of ways we can resolve the ambiguity:

1. *Explicitly override the conflicting rules.*
   The example shows that rule 1 overrides rule 4 (they would have had to have started work at age 2!). Rule 2 overrides both rules 4 and 5. Rule 3 overrides rule 5.
   Often spec authors will use the override approach in English because they are too lazy to figure out the precise conditions.

Conditions	1	2	3	4	5
Age	< 18	>= 60	18..59	-	>= 45
Service	-	-	>= 30	15..29	-
Actions	◄				
Post Message(s)					
Extra Days	5	5	5	2	2
Overrides	4	{4, 5}	5		

2. *Make the rules more precise.* This is preferred over using overrides. Though it does take a bit more brain work. Explicit logic is usually easier to follow than overrides. And since overrides are really just more rules it's better to make them part of the decision table conditions.

Conditions	1	2	3	4	5
Age	< 18	>= 60	18..59	18..59	45..59
Service	-	-	>= 30	15..29	< 30
Actions	◄				
Post Message(s)					
Extra Days	5	5	5	2	2

The final result with all the rules is:

Conditions	0	1	2	3	4	5	6
Age		< 18	>= 60	18..59	>= 60	18..59	45..59
Service		-	-	>= 30	>= 30	15..29	< 30
Actions	◄						
Post Message(s)	☑	☑	☑	☑	☑	☑	
Base Days	22						
Extra Days		5	5	5	3	2	2

NOTE: Corticon will still tell us there is still a "potential" conflict between rules 2 and 4. However this is actually OK since the spec says the 3 days **can** be combined with the 5.

Conditions	0	1	2	3	4	5	6
Age		< 18	>= 60	18..59	>= 60	18..59	45..59
Service		-	-	>= 30	>= 30	15..29	< 30
Actions	◄						
Post Message(s)	☑	☑	☑	☑	☑	☑	
Base Days	22						
Extra Days		5	5	5	3	2	2

Completeness

Corticon is able to detect that there is no rule for the following combinations of conditions.

Since no extra days are currently given for these conditions we could omit this rule. However by leaving it in we can explicitly set the extra days to zero so there is no misunderstanding and generate an explicit message that indicates the precise reason an employee did not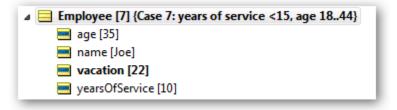 get extra days. This is often helpful in eligibility determination rule models. Applicants always want to know why they didn't qualify.

Conditions	7
Age	[18..44]
Service	< 15
Actions	◄
Post Message(s)	
Base Days	
Extra Days	

 E.g.

"Employees do not get extra days when years of service is less than 15 and age is 18 - 44"

Of course alternatively we might realize that this was an omission from the original spec and that these employees also should get some allocation of days. In this case we could enter a non-zero amount for extra days.
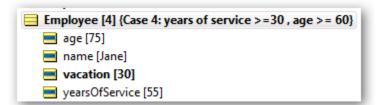
Some Test Cases

Employee [7] {Case 7: years of service <15, age 18..44}
- age [35]
- name [Joe]
- **vacation [22]**
- yearsOfService [10]

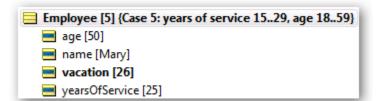[Challenge,0] Base: Every employee receives at least 22 days
[Challenge,7] Employees do not get extra days when years of service is less than 15 and age is 18 - 44
[Vacation_Summary,0] Joe is entitled to 22 days of vacation

Employee [4] {Case 4: years of service >=30 , age >= 60}
- age [75]
- name [Jane]
- **vacation [30]**
- yearsOfService [55]

[Challenge,0] Base: Every employee receives at least 22 days
[Challenge,2] 1B. Only employees at least 60 receive 5 extra days
[Challenge,4] 2. Employees with at least 30 years of service and [also employees of] age 60 or more receive 3 extra days on top of other days
[Vacation_Summary,0] Jane is entitled to 30 days of vacation

Employee [5] {Case 5: years of service 15..29, age 18..59}
- age [50]
- name [Mary]
- **vacation [26]**
- yearsOfService [25]

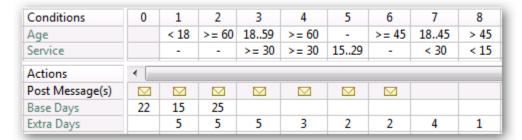[Challenge,0] Base: Every employee receives at least 22 days
[Challenge,5] 3A. If an employee has at least 15 but less than 30 years of service 2 extra days are given. They cannot be combined with the 5 extra days.
[Challenge,6] 3B. These 2 days are also provided for employees age 45 or more. They cannot be combined with the 5 extra days.
[Vacation_Summary,0] Mary is entitled to 26 days of vacation

Flexibility

Modeling this decision was not very hard once we determined exactly what behavior was required. But of course rules often change. So how robust is this decision model when we make changes such as these:

1. Under 18 base days is 15; 60 and over base days is 25
2. Employees between 18 and 45 get 4 days if they have less than 30 year's service
3. Employees over 45 get 1 extra day if they have less than 15 year's service
4. All days can be combined

Conditions	0	1	2	3	4	5	6	7	8
Age		< 18	>= 60	18..59	>= 60	-	>= 45	18..45	> 45
Service		-	-	>= 30	>= 30	15..29	-	< 30	< 15
Actions	◄								
Post Message(s)	☑	☑	☑	☑	☑	☑	☑		
Base Days	22	15	25						
Extra Days		5	5	5	3	2	2	4	1

Everyone now gets some extra days under these new rules (since the completeness checker will show there are no missing rules)

Appendix A The Challenge

The number of vacation days depends on age and years of service.

Every employee receives at least 22 days.
Additional days are provided according to the following criteria:

1) Only employees younger than 18 or at least 60 years, or employees with at least 30 years of service will receive 5 extra days.

2) Employees with at least 30 years of service and also employees of age 60 or more, receive 3 extra days, on top of possible additional days already given.

3) If an employee has at least 15 but less than 30 years of service, 2 extra days are given. These 2 days are also provided for employees of age 45 or more. These 2 extra days can not be combined with the 5 extra days.