

HW02: Model-Based – DT, &k-Map

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Course: SSW-567

Assignment Description

Part I:

Do Problem 8 on page 131 of Jorgensen's Software Testing.

For your reference, I've included the problem here:

"The retirement pension salary of a Michigan public school teacher is a percentage of the average of their last 3 years of teaching. Normally, the number of years of teaching service is the percentage multiplier. To encourage senior teachers to retire early, the Michigan legislature enacted the following incentive in May of 2010:

Teachers must apply for the incentive before June 11, 2010. Teachers who are currently eligible to retire (age ≥ 63 years) shall have a multiplier of 1.6% on their salary up to, and including, \$90,000, and 1.5% on compensation in excess of \$90,000. Teacher who meet the 80 total years of age plus years of teaching shall have a multiplier of 1.55% on their salary up to, and including, \$90,000 and 1.5% on compensation in excess of \$90,000.

Make a Decision Table to describe the retirement pension policy; be sure to consider the retirement eligibility criteria carefully. What are the compensation multiplier for a person who is currently 64 with 20 years of teaching whose salary is \$95,000? Comment on the completeness and vagueness of the requirements. If possible, calculate the default rules. "

Be sure to include your assumptions and complete decision table plus any reductions that simplify the table to reach your final answer.

You must include a decision table as part of your submission.

Part II:

You are required to test software filter for the selection of male students into the male basketball team of the university. The basketball league wouldn't allow players to represent their university unless each player has at least 12 credits per term within the university. The university coach is interested only in players who weigh more than 180 pounds and are at least 77 inch tall. You are required to:

- 1) Identify the input conditions and corresponding actions.
- 2) Provide the initial Decision Table, reduce it and show the reductions steps.
- 3) Comment on the completeness and vagueness of the requirements.
- 4) If possible, calculate the default rules.

Answer:

Part 1

Assumptions

- **Average Salary:** The provided salary of \$95,000 is the average of the last three years of teaching, used directly for pension calculations.
- **Incentive Eligibility Precedence:** When a teacher qualifies for both incentive programs (age ≥ 63 and age + years of service ≥ 80), the policy with the more favorable multiplier is applied. In this case, the age-based incentive (1.6% vs. 1.55% for the first \$90,000) is more favorable.
- **Default Rule:** The "normal" pension policy is the default, applying to teachers who do not meet any incentive criteria. Their pension multiplier is their years of teaching service.

Decision Table for Teacher Retirement Pension Policy

This decision table shows the conditions and corresponding actions for the teacher retirement pension. The rules are simplified to reflect the precedence of the more favorable multiplier.

Conditions / Actions	Rule 1	Rule 2	Rule 3
Conditions			
Age ≥ 63 years	Y	N	-
Age + Years of Service ≥ 80	-	Y	N
Actions			
Compensation Multiplier (up to \$90,000)	1.6%	1.55%	Years of Service %
Compensation Multiplier (above \$90,000)	1.5%	1.5%	Years of Service %
Rule Description	Age-based incentive	Age+Service incentive	No incentive (Default)

Reduction Steps

The initial problem text presents two distinct incentive conditions. However, a teacher could satisfy both. By applying the assumption that the more beneficial rule takes precedence, we simplify the table.

- Rule 1: A teacher meeting the **age ≥ 63** condition gets the 1.6% multiplier, regardless of whether they also meet the age + years of service rule. This is because 1.6% is higher than 1.55%.
- Rule 2: A teacher who is **not** age ≥ 63 , but meets the **age + years of service ≥ 80** condition, gets the 1.55% multiplier.

- Rule 3: All other teachers fall under the **default** "no incentive" rule, where the multiplier is their years of service.

Pension Calculation for a Specific Teacher

A teacher who is **64 years old** with **20 years of teaching** and an average salary of **\$95,000** meets the conditions for **Rule 1**.

- **Age:** $64 \geq 63$ (met)
- **Age + Years of Service:** $64 + 20 = 84 \geq 80$ (also met, but the age rule takes precedence)

Based on Rule 1, the applicable multipliers are **1.6%** for salary up to \$90,000 and **1.5%** for salary over \$90,000.

- Pension on the first **\$90,000**: $90,000 \times 0.016 = \$1,440$
- Pension on the remaining salary (**\$95,000 - \$90,000 = \$5,000**): $5,000 \times 0.015 = \$75$
- **Total Pension:** $\$1,440 + \$75 = \$1,515$ (per year, as is standard for pension calculations)

The compensation multipliers for this person are **1.6%** for the first \$90,000 and **1.5%** for the amount above \$90,000.

Completeness and Vagueness of Requirements

- **Completeness:** The requirements are generally complete, providing clear eligibility criteria and corresponding multipliers for both incentive programs and the default rule.
- **Vagueness:** The primary area of vagueness is the lack of a **precedence rule** for teachers who meet both incentive conditions. The text does not specify which multiplier to use, requiring an assumption to be made for a definitive calculation. Our assumption of applying the most favorable multiplier is logical but not explicitly stated. Additionally, the problem doesn't clarify whether the calculated pension is a monthly or annual amount.

Part 2

1) Input Conditions and Corresponding Actions

- **Input Conditions:** These are the criteria used to filter students for the team.
 1. **Gender:** Is the student male?
 2. **Credits:** Does the student have at least 12 credits per term (≥ 12)?
 3. **Weight:** Is the student's weight greater than 180 pounds (> 180 lbs)?
 4. **Height:** Is the student's height at least 77 inches (≥ 77 in)?
- **Corresponding Actions:** These are the outcomes of the selection process.
 - **Action 1:** Select student for the team.

- **Action 2:** Reject student.

2) Initial and Reduced Decision Table

Initial Decision Table

This table has 16 rules, representing all possible combinations of the four conditions ($2^4 = 16$).

The "Y" (Yes), "N" (No), and "-" (Don't Care) notation is used.

Conditions / Actions	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16
Male?	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N
Credits \geq 12?	Y	Y	Y	Y	N	N	N	N	-	-	-	-	-	-	-	-
Weight > 180 lbs?	Y	Y	N	N	-	-	-	-	-	-	-	-	-	-	-	-
Height \geq 77 in?	Y	N	Y	N	-	-	-	-	-	-	-	-	-	-	-	-
Actions																
Select	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Reject		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Reduction Steps:

- **Step 1:** The most significant reduction comes from the "Male?" condition. If the student is not male (N), they are rejected regardless of the other conditions. This eliminates rules 9-16.
- **Step 2:** The "Credits \geq 12" condition is also a hard filter. If the student does not have enough credits (N), they are rejected regardless of weight and height. This eliminates rules 5-8.
- **Step 3:** The "Weight > 180 lbs" and "Height \geq 77 in" conditions are the last filters. A student must satisfy **both** to be selected. If either condition is "N," the student is rejected. This combines rules 2-4 into a single rejection rule.
- **Final Result:** The only way to be selected is to meet all four conditions. Any deviation leads to rejection.

Reduce Decision Table

Conditions / Actions	Rule 1	Rule 2	Rule 3
Conditions			
Male?	Y	N	Y
Credits \geq 12?	Y	Y	N
Weight > 180 lbs?	Y	Y	-
Height \geq 77 in?	Y	N	-
Actions			
Select	✓		
Reject		✓	✓

- Further Reduction: We can combine rules 2 and 3 into a single default "Reject" rule. The only path to selection is to meet all four criteria. Any other combination results in rejection.

Final Reduced Decision Table

Conditions / Actions	Rule 1	Rule 2 (Default)
Conditions		
Male?	Y	-
Credits ≥ 12?	Y	-
Weight > 180 lbs?	Y	-
Height ≥ 77 in?	Y	-
Actions		
Select	✓	
Reject		✓

3) Completeness and Vagueness of Requirements

Completeness: The requirements are complete. They clearly define all the necessary conditions (gender, credits, weight, and height) and the single action for selection. There are no missing conditions or outcomes that would prevent the decision table from being fully defined.

Vagueness: There is no significant vagueness. The numerical criteria are precise and unambiguous (≥ 12 , > 180 , ≥ 77). The "male" condition is also a clear binary choice. The prompt states the university "coach is interested only in" players who meet the weight and height criteria, which implies that all four conditions must be met for selection.

4) Default Rules

The default rule is to reject a student. This rule applies to any student who does not meet all four of the selection criteria (Male, ≥ 12 credits, > 180 lbs, ≥ 77 in). The only way to get a "Select" action is to match the single explicit rule in the final reduced table.