

## **1. Retailer (Retailer\_ID, Retailer\_name, Area, Retailer\_Contact\_info)**

### **1NF:**

- All attributes are atomic (e.g., Retailer\_name is a single value).
- No repeating groups.

### **2NF:**

- Primary Key: Retailer\_ID
- All non-prime attributes (Retailer\_name, Area, Retailer\_Contact\_info) are fully functionally dependent on the whole primary key, which is atomic.

### **3NF:**

- No transitive dependencies. Every non-prime attribute depends only on the key.

### **BCNF:**

- All determinants are candidate keys. Here, only Retailer\_ID determines everything else.

### **4NF:**

- No multivalued dependencies. One retailer has only one name, one area, one contact—no independent multivalued facts.

## **2. Inventory (Inventory\_ID, Product\_ID, Quantity\_data)**

### **1NF:**

- **Attributes are atomic.**
- **No repeating groups.**

### **2NF:**

- **Primary Key: Inventory\_ID**
- **Product\_ID and Quantity\_data are fully dependent on Inventory\_ID.**

### **3NF:**

- **No transitive dependencies.**

### **BCNF:**

- **All functional dependencies have candidate keys as determinants.**

### **4NF:**

- **No independent multivalued dependencies like multiple Product\_IDs for same inventory or vice versa.**

### **3. Product (Product\_ID, Product\_name, Mfg\_date, Exp\_date, Price)**

#### **1NF:**

- All values are atomic.

#### **2NF:**

- Primary Key: Product\_ID
- All other attributes are fully dependent on Product\_ID.

#### **3NF:**

- No transitive dependencies.
- For example, Exp\_date is not dependent on Mfg\_date but directly on Product\_ID.

#### **BCNF:**

- All dependencies are of the form Product\_ID → other attributes.

#### **4NF:**

- There are no independent multivalued facts. Each product has exactly one name, one manufacturing and expiry date, and one price.

## **4. Made\_Of (Product\_ID, Material\_ID, Category)**

### **1NF:**

- All fields are atomic, even Category.

### **2NF:**

- Composite key: (Product\_ID, Material\_ID)
- Category is fully dependent on the combination of Product\_ID and Material\_ID.

### **3NF:**

- No transitive dependencies (e.g., Category doesn't depend on Product\_ID or Material\_ID separately).

### **BCNF:**

- Both determinants in FDs are candidate keys (composite key).

### **4NF:**

- No independent multivalued dependencies: the relation captures one material for one product with one category.

## **5. Material (Material\_ID, Supplier\_ID, Material\_name)**

### **1NF:**

- Atomic attributes, no lists or sets.

### **2NF:**

- Primary Key: Material\_ID
- Material\_name and Supplier\_ID are fully dependent on it.

### **3NF:**

- No transitive dependency among attributes.

### **BCNF:**

- Only one FD: Material\_ID  $\rightarrow$  Supplier\_ID, Material\_name, and Material\_ID is a candidate key.

### **4NF:**

- No multivalued dependencies such as multiple suppliers for a single material independently.

## **6. Supplier (Supplier\_ID, Supplier\_name, Supplier\_contact)**

### **1NF:**

- Atomic attributes.

### **2NF:**

- Primary Key: Supplier\_ID
- All non-prime attributes depend fully on it.

### **3NF:**

- No transitive dependencies.

### **BCNF:**

- Functional dependency  $\text{Supplier\_ID} \rightarrow \text{Supplier\_name}, \text{Supplier\_contact}$  satisfies BCNF.

### **4NF:**

- No separate sets of values per supplier (e.g., multiple names or contacts).

## **7. Retail\_Orders (Retail\_order\_ID, Retailer\_ID, Retail\_Order\_date, Retailer\_Pay\_ID)**

### **1NF:**

- No repeating groups, all values atomic.

### **2NF:**

- Retail\_order\_ID is the primary key, and all other fields are fully dependent.

### **3NF:**

- Retailer\_Pay\_ID does not determine any other non-key attribute. No transitive dependencies.

### **BCNF:**

- All FDs have candidate keys as determinants.

### **4NF:**

- Each order has one retailer, one payment, and one date—no multivalued dependencies.

## **8. Retail\_Order\_Details (Retail\_order\_ID, Product\_ID, Quantity\_Ordered, Selling\_Price)**

**1NF:**

- Atomic attributes.

**2NF:**

- Composite Key: (Retail\_order\_ID, Product\_ID)
- Quantity\_Ordered, Selling\_Price are dependent on the full key.

**3NF:**

- No transitive dependencies.

**BCNF:**

- Composite candidate key used for all FDs.

**4NF:**

- No independent sets of Product\_ID or Retail\_order\_ID values—each tuple is unique per combo.



## **9. Retailer\_payment (Retailer\_pay\_ID, Received\_amount, Method, Pay\_date)**

### **1NF:**

- All fields are atomic.

### **2NF:**

- Retailer\_pay\_ID is the PK, all others depend fully on it.

### **3NF:**

- No field determines another non-key attribute.

### **BCNF:**

- One candidate key only; all dependencies valid.

### **4NF:**

- No independent sets of Method, Received\_amount, or Pay\_date.

## **10. Supply\_Order (Supply\_order\_ID, Supplier\_ID, Supply\_order\_date, Supplier\_Pay\_ID)**

### **1NF:**

- Atomic fields, single values only.

### **2NF:**

- Primary Key: Supply\_order\_ID
- All attributes depend fully on it.

### **3NF:**

- Supplier\_Pay\_ID doesn't determine other attributes—no transitive dependencies.

### **BCNF:**

- All FDs have keys on the LHS.

### **4NF:**

- Every supplier order is linked to only one supplier and payment, so no multivalued dependencies.

## **11. Supply\_Order\_Detail (Supply\_order\_ID, Material\_ID, Quantity, Cost\_price)**

### **1NF:**

- Atomic data.

### **2NF:**

- Composite PK: (Supply\_order\_ID, Material\_ID)
- Quantity, Cost\_price depend fully on the full key.

### **3NF:**

- No transitive dependencies.

### **BCNF:**

- All FDs have composite key on LHS.

### **4NF:**

- No multivalued dependencies for same supplier order and material.

## **12. Supplier\_Payment (Supplier\_pay\_ID, Paid\_amount, Paid\_date)**

**1NF:**

- Atomic attributes.

**2NF:**

- Primary Key: Supplier\_pay\_ID, others are dependent on it.

**3NF:**

- No attribute determines another.

**BCNF:**

- One candidate key only.

**4NF:**

- One amount and date per payment ID—no multivalued dependencies.