The first normal form requires that no column has more than one value stored in a cell. In other words, it should only store atomic values. None of the tables in the database *shoeshop* holdcolumns containing multiple values.

As for the second normal form, it states that the first normal form must be granted (as we’ve said it is) but also no non-prime attribute is dependent on the proper subset of any candidate key of a table. In our tables there aren´t any redundancies nor separable values disrespecting the second normal form.

Finally, the third normal form requires that the second normal form is fulfilled and that no transitive functional dependency of non-prime attribute on any super key should exist.

Since in all of our database's tables all attribute types are fully functional dependent on the primary key of their table and all attribute types are atomic and single-valued and there are no transitive dependencies, all tables are in the third normal form.

The tables below detail the dependencies between each table’s fields, showing there are no transitive functional dependencies.

**3NF Demonstration**

|  |  |  |
| --- | --- | --- |
| Field 1 | Field 2 | Dependency |
| customer\_id (pk) | name | PK Dependency |
| customer\_id (pk) | phone\_number | PK Dependency |
| customer\_id (pk) | phone\_number\_country\_prefix | PK Dependency |
| customer\_id (pk) | email\_address | PK Dependency |
| customer\_id (pk) | home\_address | PK Dependency |
| customer\_id (pk) | spending\_score | PK Dependency |
| customer\_id (pk) | spending\_category | PK Dependency |
| customer\_id (pk) | age | PK Dependency |
| name | phone\_number | None |
| name | phone\_number\_country\_prefix | None |
| name | email\_address | None |
| name | home\_address | None |
| name | spending\_score | None |
| name | spending\_category | None |
| name | age | None |
| phone\_number | phone\_number\_country\_prefix | None |
| phone\_number | email\_address | None |
| phone\_number | home\_address | None |
| phone\_number | spending\_score | None |
| phone\_number | spending\_category | None |
| phone\_number | age | None |
| phone\_number\_country\_prefix | email\_address | None |
| phone\_number\_country\_prefix | home\_address | None |
| phone\_number\_country\_prefix | spending\_score | None |
| phone\_number\_country\_prefix | spending\_category | None |
| phone\_number\_country\_prefix | age | None |
| email\_address | home\_address | None |
| email\_address | spending\_score | None |
| email\_address | spending\_category | None |
| email\_address | age | None |
| home\_address | spending\_score | None |
| home\_address | spending\_category | None |
| home\_address | age | None |
| spending\_score | spending\_category | None |
| spending\_score | age | None |

Table 1: Customer

|  |  |  |
| --- | --- | --- |
| Field 1 | Field 2 | Dependency |
| supplier\_id (pk) | name | PK Dependency |
| supplier\_id (pk) | phone\_number | PK Dependency |
| supplier \_id (pk) | email\_address | PK Dependency |
| supplier\_id (pk) | business\_address | PK Dependency |
| name | phone\_number | None |
| name | email\_address | None |
| name | business\_address | None |
| phone\_number | email\_address | None |
| phone\_number | business\_address | None |
| email\_address | business\_address | None |

Table 2: Supplier

|  |  |  |
| --- | --- | --- |
| Field 1 | Field 2 | Dependency |
| product\_id (pk) | name | PK Dependency |
| product\_id (pk) | type | PK Dependency |
| product\_id (pk) | available\_quantity | PK Dependency |
| product\_id (pk) | unit\_price | PK Dependency |
| name | type | None |
| name | available\_quantity | None |
| name | unit\_price | None |
| type | available\_quantity | None |
| type | unit\_price | None |
| available\_quantity | unit\_price | None |

Table 3: Stock

|  |  |  |
| --- | --- | --- |
| Field 1 | Field 2 | Dependency |
| supplier\_order\_and\_invoice\_ID (pk) | order\_date | PK Dependency |
| supplier\_order\_and\_invoice\_ID (pk) | products\_received | PK Dependency |
| supplier\_order\_and\_invoice\_ID (pk) | supplier\_id | PK Dependency |
| supplier\_order\_and\_invoice\_ID (pk) | invoice\_date | PK Dependency |
| supplier\_order\_and\_invoice\_ID (pk) | paid | PK Dependency |
| order\_date | products\_received | None |
| order\_date | supplier\_id | None |
| order\_date | invoice\_date | None |
| order\_date | paid | None |
| products\_received | supplier\_id | None |
| products\_received | invoice\_date | None |
| products\_received | paid | None |
| supplier\_id | invoice\_date | None |
| supplier\_id | paid | None |
| invoice\_date | paid | None |

Table 4: Supplier\_Order

|  |  |  |
| --- | --- | --- |
| Field 1 | Field 2 | Dependency |
| order\_item\_id (pk) | supplier\_order\_and\_invoice\_ID | PK Dependency |
| order\_item\_id (pk) | product\_id | PK Dependency |
| order\_item\_id (pk) | quantity | PK Dependency |
| supplier\_order\_and\_invoice\_ID | product\_id | None |
| supplier\_order\_and\_invoice\_ID | quantity | None |
| product\_id | quantity | None |

Table 5: Supplier\_Order\_Item

|  |  |  |
| --- | --- | --- |
| Field 1 | Field 2 | Dependency |
| customer\_order\_and\_invoice\_ID (pk) | order\_date | PK Dependency |
| customer\_order\_and\_invoice\_ID (pk) | shipping\_date | PK Dependency |
| customer\_order\_and\_invoice\_ID (pk) | customer\_id | PK Dependency |
| customer\_order\_and\_invoice\_ID (pk) | shipping\_adress | PK Dependency |
| customer\_order\_and\_invoice\_ID (pk) | payment\_received | PK Dependency |
| customer\_order\_and\_invoice\_ID (pk) | invoice\_date | PK Dependency |
| customer\_order\_and\_invoice\_ID (pk) | invoice\_address | PK Dependency |
| customer\_order\_and\_invoice\_ID (pk) | tax\_percent\_rate | PK Dependency |
| order\_date | shipping\_date | None |
| order\_date | customer\_id | None |
| order\_date | shipping\_adress | None |
| order\_date | payment\_received | None |
| order\_date | invoice\_date | None |
| order\_date | invoice\_address | None |
| order\_date | tax\_percent\_rate | None |
| shipping\_date | customer\_id | None |
| shipping\_date | shipping\_adress | None |
| shipping\_date | payment\_received | None |
| shipping\_date | invoice\_date | None |
| shipping\_date | invoice\_address | None |
| shipping\_date | tax\_percent\_rate | None |
| customer\_id | shipping\_adress | None |
| customer\_id | payment\_received | None |
| customer\_id | invoice\_date | None |
| customer\_id | invoice\_address | None |
| customer\_id | tax\_percent\_rate | None |
| shipping\_adress | payment\_received | None |
| shipping\_adress | invoice\_date | None |
| shipping\_adress | invoice\_address | None |
| shipping\_adress | tax\_percent\_rate | None |
| payment\_received | invoice\_date | None |
| payment\_received | invoice\_address | None |
| payment\_received | tax\_percent\_rate | None |
| invoice\_date | invoice\_address | None |
| invoice\_date | tax\_percent\_rate | None |
| invoice\_address | tax\_percent\_rate | None |

Table 6: Customer\_Order

|  |  |  |
| --- | --- | --- |
| Field 1 | Field 2 | Dependency |
| order\_item\_id (pk) | customer\_order\_and\_invoice\_ID | PK Dependency |
| order\_item\_id (pk) | product\_id | PK Dependency |
| order\_item\_id (pk) | quantity | PK Dependency |
| order\_item\_id (pk) | discount\_percent | PK Dependency |
| order\_item\_id (pk) | rating | PK Dependency |
| order\_item\_id (pk) | value\_at\_time | PK Dependency |
| customer\_order\_and\_invoice\_ID | product\_id | None |
| customer\_order\_and\_invoice\_ID | quantity | None |
| customer\_order\_and\_invoice\_ID | discount\_percent | None |
| customer\_order\_and\_invoice\_ID | rating | None |
| customer\_order\_and\_invoice\_ID | value\_at\_time | None |
| product\_id | quantity | None |
| product\_id | discount\_percent | None |
| product\_id | rating | None |
| product\_id | value\_at\_time | None |
| quantity | discount\_percent | None |
| quantity | rating | None |
| quantity | value\_at\_time | None |
| discount\_percent | rating | None |
| discount\_percent | value\_at\_time | None |
| rating | value\_at\_time | None |

Table 7: Customer\_Order\_Item

|  |  |  |
| --- | --- | --- |
| Field 1 | Field 2 | Dependency |
| log\_id (pk) | product\_id | PK Dependency |
| log\_id (pk) | old\_unit\_price | PK Dependency |
| log\_id (pk) | new\_unit\_price | PK Dependency |
| log\_id (pk) | update\_date | PK Dependency |
| product\_id | old\_unit\_price | None |
| product\_id | new\_unit\_price | None |
| product\_id | update\_date | None |
| old\_unit\_price | new\_unit\_price | None |
| old\_unit\_price | update\_date | None |
| new\_unit\_price | update\_date | None |

Table 8: Log\_Price