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1 Database Design and Implementation

1.1 E-R Diagram Design

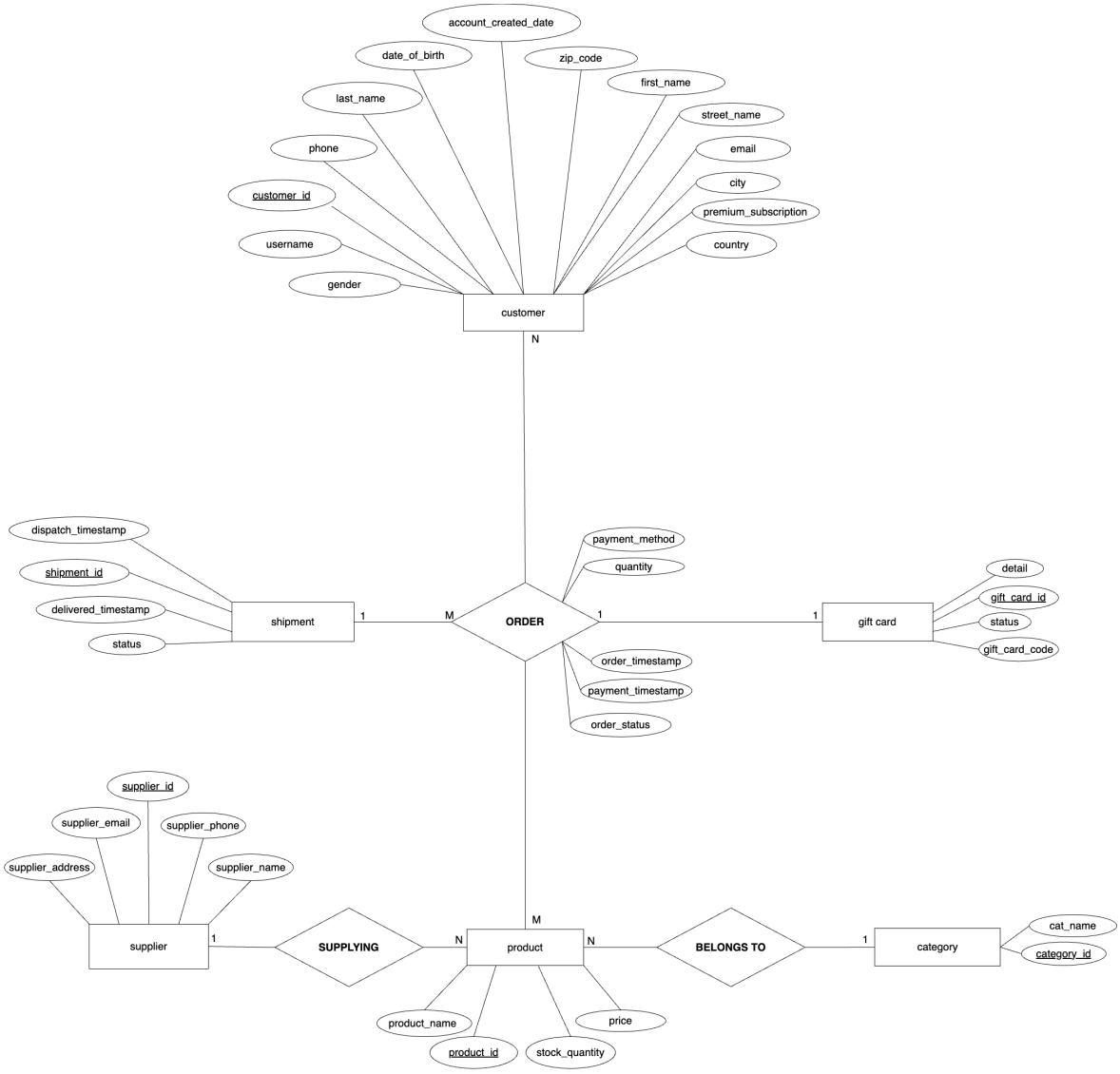


Figure 1: Github Action Workflow

1.2 Relationship Sets

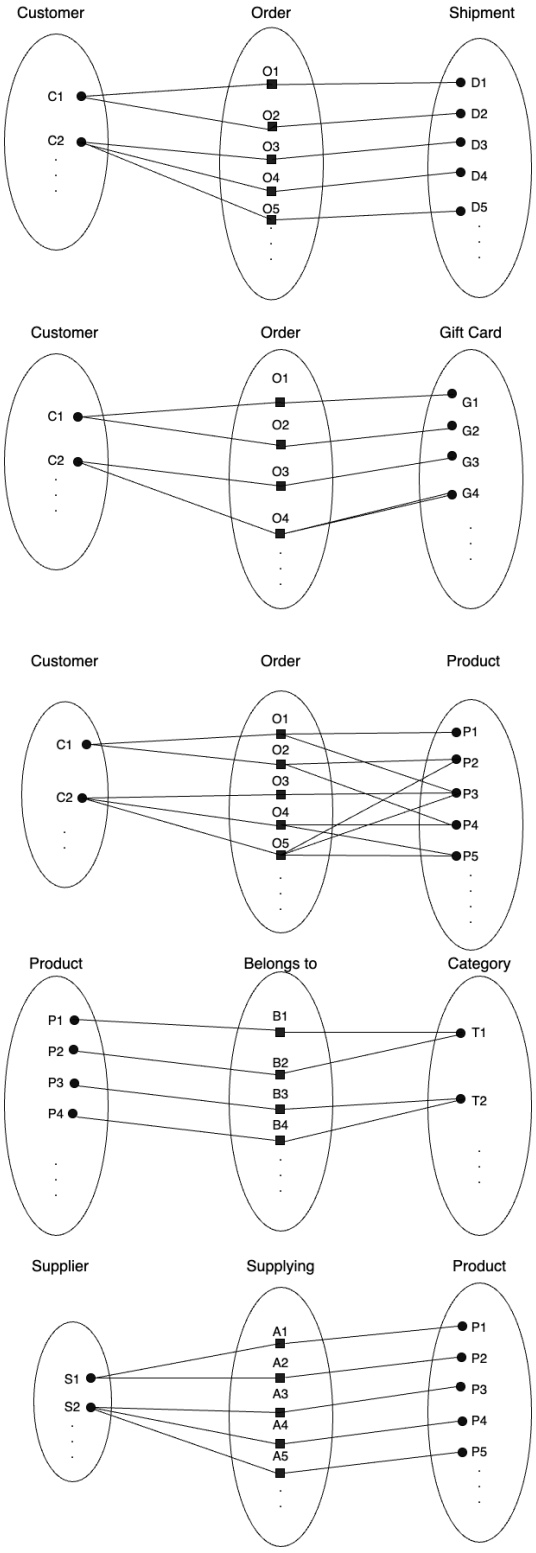


Figure 2: Github[4]Action Workflow

1.2.1 Cardinalities:

- A customer can have multiple orders (**1:N** relationship between **CUSTOMERS** and **ORDERS**).
- We assume that a customer can order only one type of product.
- A product belongs to only one category, but a category can have multiple products (**1:N** relationship between **PRODUCT_CATERGORY** and **PRODUCTS**).
- A supplier can supply many products (**1:N** relationship between **SUPPLIERS** and **PRODUCTS**).
- An order results in one shipment but one shipment can contain multiple orders(**1:M** relationship between **ORDERS** and **SHIPMENTS**).
- A gift card can be associated with only one order (**1:1** relationship between **GIFT_CARDS** and **ORDERS**).

1.2.2 Assumptions:

- Every Order must have a Customer, but a Customer does not necessarily need to have an Order.
- If a customer buys several things on the same day, and if all those things are coming from the same place, they'll be packed together and sent off with one tracking number.
- Our e-commerce business operates directly with suppliers, and we do not have any storage facilities for inventory.
- Every customer, product category, supplier, product, gift card, order, and shipment is uniquely identified by their respective ID fields (**customer_id, category_id, supplier_id, product_id, gift_card_id, order_id, shipment_id**).
- Orders reference **CUSTOMERS, PRODUCTS, SHIPMENT,** and **GIFT_CARD** through their respective ID fields, establishing a connection to existing records in those tables.
- Products reference **PRODUCT_CATEGORY** and **SUPPLIERS** through **category_id** and **supplier_id**, ensuring that each product is linked to existing categories and suppliers.
- **Mandatory Information**:
  - Customers must have a **customer_id, first_name, and date_of_birth**.
  - Products must have a **product_id, stock_quantity, category_id, and supplier_id**.
  - Orders must have an **order_id and order_status**.

  - Shipments must have a **shipment_id and status**.

- **Nullable Fields**: Some fields are optional, such as last_name for customers, which suggests that not all information is required to create a record in the database.
- **Data Type Restrictions**: Email and phone fields for customers and supplier_email for suppliers are unique, implying that no two records can have the same value for these fields.
- **premium_subscription** in **CUSTOMERS** is an integer, which is indicated using a **boolean** value (0 or 1)
- The price in **PRODUCTS** is of type **REAL**, allowing for decimal values.
- **Gift Cards**: Gift cards are considered an entity but might not be required for an order, as the gift_card_id in the ORDERS table can be null.
- **Shipment Process**: The **SHIPMENT** table's **dispatch_timestamp** and **delivered_timestamp** suggest tracking the timeline of a shipment but they're not set as NOT NULL, so there might be cases where a shipment is created in the system before an actual dispatch time is known.
- **Payment and Order Timing**: Orders have both an **order_timestamp** and a **payment_timestamp**, which may not always be the same—this allows tracking the time the order was made and when the payment was processed.
- **Stock Management**: stock_quantity in PRODUCTS suggests the system tracks inventory levels, but there is no direct link to orders for decrementing stock, which implies this might be managed by a separate process or system.
- **Data Consistency**: The use of foreign keys enforces data consistency, ensuring that records in linked tables must exist before they can be referenced in an association.

1.3 SQL Database Schema Creation

This code is like organizing a digital warehouse for an e-commerce business. It sets up different sections in a database for storing information about customers, product categories, suppliers, products, gift cards, orders, and shipments. Each section is designed to keep specific types of information, ensuring that everything from customer details to order and shipment records is neatly organized and interconnected. The code ensures that each item, whether a customer or a product, is unique and correctly linked to related information, like linking a product to its supplier. It's like setting up shelves and labeling them in a warehouse to ensure everything is easy to find and in the right place.

```r
#connect to the SQLite database
my_connection <- RSQLite::dbConnect(RSQLite::SQLite(),
                                    "../database/ecommerce_database_v1.db")


dbExecute(my_connection,
                "CREATE TABLE IF NOT EXISTS CUSTOMERS
                (
                    customer_id VARCHAR(255) NOT NULL PRIMARY KEY,
                    first_name VARCHAR(255) NOT NULL,
                    last_name VARCHAR(255),
                    username VARCHAR(255),
                    gender TEXT,
                    date_of_birth DATE NOT NULL,
                    email VARCHAR(255) UNIQUE,
                    phone VARCHAR(20) UNIQUE,
                    street_name VARCHAR(255),
                    city VARCHAR(255),
                    country VARCHAR(255),
                    zip_code VARCHAR(20),
                    account_created_date TIMESTAMP,
                    premium_subscription INTEGER
                );"
          )

dbExecute(my_connection,
                "CREATE TABLE IF NOT EXISTS PRODUCT_CATEGORY
                (
                    category_id VARCHAR(255) NOT NULL PRIMARY KEY,
                    cat_name VARCHAR(255)
                );"
          )

dbExecute(my_connection,
                "CREATE TABLE IF NOT EXISTS SUPPLIERS
                (
                    supplier_id VARCHAR(255) NOT NULL PRIMARY KEY,
                    supplier_name VARCHAR(255),
                    supplier_address VARCHAR(500),
                    supplier_phone VARCHAR(20),
                    supplier_email VARCHAR(255) UNIQUE
                );"
```

```
          )

dbExecute(my_connection,
                "CREATE TABLE IF NOT EXISTS PRODUCTS
                (
                    product_id VARCHAR(255) NOT NULL PRIMARY KEY,
                    product_name VARCHAR(255),
                    price REAL,
                    stock_quantity INTEGER NOT NULL,
                    category_id VARCHAR(255) NOT NULL,
                    supplier_id VARCHAR(255) NOT NULL,
                    FOREIGN KEY(category_id) REFERENCES
                          PRODUCT_CATEGORY(category_id),
                    FOREIGN KEY(supplier_id) REFERENCES SUPPLIERS(supplier_id)
                );"
          )

dbExecute(my_connection,
                "CREATE TABLE IF NOT EXISTS GIFT_CARD
                (
                gift_card_id VARCHAR(50) NOT NULL PRIMARY KEY,
                gift_card_code VARCHAR(50),
                detail INTEGER,
                status VARCHAR(50)
                );"
          )
dbExecute(my_connection,
                "CREATE TABLE IF NOT EXISTS ORDERS
                (
                    order_id VARCHAR(255) NOT NULL PRIMARY KEY,
                    customer_id VARCHAR(255),
                    product_id VARCHAR(255),
                    gift_card_id VARCHAR(255),
                    payment_method TEXT,
                    quantity INTEGER,
                    order_timestamp TIMESTAMP,
                    payment_timestamp TIMESTAMP,
                    order_status VARCHAR(50) NOT NULL,
                    shipment_id VARCHAR(255),
                    FOREIGN KEY(customer_id) REFERENCES CUSTOMERS(customer_id),
                    FOREIGN KEY(product_id) REFERENCES PRODUCTS(product_id),
                    FOREIGN KEY(shipment_id) REFERENCES SHIPMENT(shipment_id),
```

```
                    FOREIGN KEY(gift_card_id) REFERENCES GIFT_CARD(gift_card_id)
                );"
            )
dbExecute(my_connection,
                "CREATE TABLE IF NOT EXISTS SHIPMENT
                (
                shipment_id VARCHAR(255) NOT NULL PRIMARY KEY,
                dispatch_timestamp DATETIME,
                delivered_timestamp DATETIME,
                status VARCHAR(50) NOT NULL
                );"
            )

#Check if the tables are created

dbGetQuery(my_connection,
    sprintf("SELECT name FROM sqlite_master WHERE type='table';")
  )
```

2 Data Generation and Management

2.1 Synthetic Data Generation

This code simulates part of an e-commerce operation by creating a set of mock orders based on existing data for customers, products, suppliers, and gift cards. It goes through these steps:

1. Finding Data: It locates and organizes data files for different categories like customers and products.
2. Loading Data: The first file from each category is loaded to form datasets for analysis.
3. Sampling: A subset of products and customers is randomly selected to make the data more manageable.
4. Order Creation: It generates fake orders, pairing products with customers and applying gift cards as needed, while recording details like payment method and order status.
5. Linking Suppliers: Each order is linked to the corresponding supplier based on the product information.
6. Shipment Grouping: Unique shipment IDs are created for orders, grouping them logically for shipping.
7. Data Cleaning: The orders are refined for realism, like removing shipment details from canceled orders.
8. Gift Card Update: The status of gift cards used in the orders is updated to 'USED'.

Essentially, this script creates a realistic snapshot of transactions for analysis, reflecting various aspects of e-commerce activities.

```
## Find all files matching the pattern
customer_files <- list.files(path = "../datasets"
                             ,pattern = "CUSTOMERS.*\\.csv$",full.names = TRUE )
category_files <- list.files(path = "../datasets"
                             ,pattern = "CATEGORY.*\\.csv$",full.names = TRUE )
gift_card_files <- list.files(path = "../datasets"
                              ,pattern = "GIFT_CARDS.*\\.csv$",full.names = TRUE )
suppliers_files <- list.files(path = "../datasets"
                              ,pattern = "SUPPLIERS.*\\.csv$",full.names = TRUE )
products_files <- list.files(path = "../datasets"
                             ,pattern = "PRODUCTS.*\\.csv$",full.names = TRUE )

customers_df <- readr::read_csv(customer_files[1])
gift_card_df <- readr::read_csv(gift_card_files[1])
suppliers_df <- readr::read_csv(suppliers_files[1])
category_df <- readr::read_csv(category_files[1])
products_df <- readr::read_csv(products_files[1])



#Sample Customers

sample_size <- floor(0.2 * nrow(products_df))
sampled_product_ids <- sample(products_df$product_id
                              , size = sample_size, replace = FALSE)
sampled_products_df <- products_df[products_df$product_id
                                   %in% sampled_product_ids, ]


#Sample Products

sample_size <- floor(0.2 * nrow(customers_df))
sampled_customer_ids <- sample(customers_df$customer_id
                               , size = sample_size, replace = FALSE)
sampled_customers_df <- customers_df[customers_df$customer_id
                                     %in% sampled_customer_ids, ]


generate_orders_data <- function(n = 1000) {
  set.seed(123)
```

```r
  orders_df <- tibble(
    order_id = sprintf("%s-%04d", "ORD", 1:n),
    customer_id = sample(sampled_customers_df$customer_id, n, replace = TRUE),
    product_id = sample(sampled_products_df$product_id, n, replace = TRUE),
    gift_card_id = sample(c(NA, gift_card_df$gift_card_id), n, replace = TRUE)
    , # Assuming gift cards are used as discounts
    payment_method = sample(c("Credit Card", "Debit Card"
                              , "PayPal", "Gift Card"), n, replace = TRUE),
    quantity = sample(1:5, n, replace = TRUE),
    order_timestamp = sample(seq(as.POSIXct('2024/02/01')
                                 , as.POSIXct('2024/02/29'), by="day")
                             , n, replace = TRUE),
    payment_timestamp = order_timestamp + hours(sample(1:72, n, replace = TRUE)),
    order_status = sample(c("Processing", "Shipped", "Delivered"
                            , "Cancelled","Pending Payment","Out for Delivery")
                          , n, replace = TRUE),
  )

  # Augment the orders data frame with supplier_id using left_join
  orders_df <- orders_df %>%
    left_join(sampled_products_df %>% select(product_id, supplier_id)
              , by = "product_id") %>%
    select(order_id, customer_id, product_id, gift_card_id, payment_method
           , quantity, order_timestamp, payment_timestamp
           , order_status, supplier_id)

  return(orders_df)
}

# Generate orders data
orders_df <- generate_orders_data(n = 1000)

generate_shipment_ids <- function(df) {
  # Create a unique identifier for each group
  df <- df %>%
    mutate(date_only = as.Date(order_timestamp)) %>%
    group_by(customer_id, supplier_id, date_only) %>%
    mutate(shipment_group_id = cur_group_id()) %>%
    ungroup() %>%
    mutate(shipment_id = sprintf("SHIP%05d", shipment_group_id)) %>%
    select(-shipment_group_id, -date_only) # Clean up the extra columns
```

```
  df
}

# Apply the function to your data frame
orders_df <- generate_shipment_ids(orders_df)

# Optional: Adjusting for logical consistency (e.g.,
# cancelled orders should not have a shipment_id)
  orders_df <- orders_df %>%
    mutate(shipment_id = if_else(order_status %in%
                                   c("Cancelled","Pending Payment")
                                 , NA_character_,as.character(shipment_id)),
           payment_method = if_else(order_status == "Pending Payment"
                                    ,NA_character_,payment_method),
           gift_card_id = if_else(payment_method == "Gift Card",gift_card_id,NA_character_))
    mutate(supplier_id = NULL)

used_gift_cards <- unique(na.omit(orders_df$gift_card_id))
gift_card_df$status[gift_card_df$gift_card_id %in% used_gift_cards] <- 'USED'
```

This code transforms order data into shipment information by doing the following:

1. It sets a dispatch date for each order to either the day the order was made or the next day.
2. It then assigns a delivery date to each order, ensuring it's 2 to 14 days after the dispatch date.
3. Orders are given a status based on their current phase, like "Ready for Dispatch" if they're being processed, or "In Transit" if they've been shipped.
4. The code cleans up the data by keeping only shipment-related details, removing duplicates and any incomplete records.
5. Lastly, it updates the dispatch and delivery dates based on the shipment status, for example, clearing the delivery date for orders "In Transit."

The updated shipment details are saved, providing a clear snapshot of when orders are dispatched, expected delivery times, and their current status.

```
#Shipment Table

  shipment_df <- orders_df %>%
    mutate(
      # Dispatch date could be the same as the order date or a day after
      dispatch_timestamp = order_timestamp + days(sample(0:1, n()
```

```
                                                        , replace = TRUE)),

    # Delivered date should be after the dispatch date;
    #here I assume delivery takes between 2 to 5 days
    delivered_timestamp = dispatch_timestamp + days(sample(2:14, n()
                                                           , replace = TRUE)),

    # Randomly assign a delivery status
    status = if_else(order_status == "Processing","Ready for Dispatch"
                     ,if_else(order_status == "Shipped","In Transit"
                    ,if_else(order_status == "Out for Delivery",order_status
                   ,if_else(order_status == "Delivered",order_status,"NA"))))
  ) %>%
  # Select only the relevant columns for the shipment table
  select(shipment_id, dispatch_timestamp, delivered_timestamp, status) %>%
  # Remove duplicate rows to ensure unique shipments
  distinct()

shipment_df <- na.omit(shipment_df)


shipment_df <- shipment_df %>%
  mutate(
    # Assign NA to dispatch_timestamp if status is 'Ready for Dispatch'
    dispatch_timestamp = if_else(status == "Ready for Dispatch"
                                 , NA_Date_, dispatch_timestamp),
    delivered_timestamp = if_else(status == "Ready for Dispatch"
                                  , NA_Date_, delivered_timestamp),

    # 'In Transit' status should have a dispatch date but no delivery date
    dispatch_timestamp = if_else(status == "In Transit"
                      , Sys.Date() - days(sample(1:5, 1)), dispatch_timestamp),
    delivered_timestamp = if_else(status == "In Transit"
                      , NA_Date_, delivered_timestamp),

    # 'In Transit' status should have a dispatch date but no delivery date
    dispatch_timestamp = if_else(status == "Out for Delivery"
                    , Sys.Date() - days(sample(1:5, 1)), dispatch_timestamp),
    delivered_timestamp = if_else(status == "Out for Delivery"
                    , NA_Date_, delivered_timestamp),

    # If status is 'Delivered', both dates should be in the past,
```

```
      #with delivered after dispatched
      dispatch_timestamp = if_else(status == "Delivered" &
                                     is.na(dispatch_timestamp)
                      , Sys.Date() - days(sample(6:10, 1)), dispatch_timestamp),
      delivered_timestamp = if_else(status == "Delivered"
              , dispatch_timestamp + days(sample(1:5, 1)), delivered_timestamp)
    )

write_csv(orders_df,"../datasets/ORDERS.csv")

write_csv(shipment_df,"../datasets/SHIPMENTS.csv")
```

2.2 Data Import and Quality Assurance

This code is like a checklist for a data table, ensuring all the needed items (columns) are there. If anything's missing, it alerts you; otherwise, it confirms everything is in order.

```
check_column_match <- function(df, expected_cols) {
  # Check if all expected columns are present in the dataframe
  missing_cols <- setdiff(expected_cols, names(df))

  if (length(missing_cols) > 0) {
    stop(sprintf("The dataframe is missing these columns expected by the SQL table: %s",
                 paste(missing_cols, collapse = ", ")))
  }

  return(TRUE)
}
```

This code is like a checklist for a data table, ensuring all the needed items (columns) are there. If anything's missing, it alerts you; otherwise, it confirms everything is in order.

2.3 Task 2.2: Data Import and Quality Assurance

CUSTOMERS

This code is like a gatekeeper for customer data entering a digital database:

1. Connection: It links up with the database to start processing customer information.
2. Checklist: It verifies that each piece of incoming data has all the required fields, like name, contact info, and other personal details.

3. Validation: It ensures emails and genders are in the right format and that essential data isn't missing.
4. Updating: It adds new customer details to the database, avoiding duplicates and ensuring data is accurately recorded.
5. Wrap-Up: After processing, it closes the connection to the database to secure the data.

This is done for each batch of customer data, keeping the database current and correct.

```
ingest_customer_data <- function(df) {

  my_connection <- RSQLite::dbConnect(RSQLite::SQLite()
                                      , "../database/ecommerce_database_v1.db")
  # Data validation

  expected_cols <- c("customer_id", "first_name", "last_name", "username",
                     "gender", "date_of_birth", "email", "phone", "street_name",
                     "city", "country", "zip_code", "account_created_date",
                     "premium_subscription")

  if (!check_column_match(df, expected_cols)) return(FALSE)

  #email check
  valid_email <- grepl("^[a-zA-Z0-9._%+-]+@[a-zA-Z0-9.-]+\\.[a-zA-Z]{2,}$"
                       , df$email)
  df <- df[valid_email, ]

  #gender check
  valid_genders <- c("Male", "Female", "Other")
  df <- df[df$gender %in% valid_genders, ]


  # Data type checks (adjust according to your data frame)
  df$date_of_birth <- as.Date(df$date_of_birth,format = "%d/%m/%y")
  df$account_created_date <- as.Date(df$account_created_date,format = "%d/%m/%y")
  df$premium_subscription <- as.integer(df$premium_subscription)

  # Check for null values in NOT NULL columns
  required_columns <- c("customer_id", "first_name", "date_of_birth")
  df <- df[!rowSums(is.na(df[required_columns])) > 0, ]

  # Insert validated data into the database
  for(i in 1:nrow(df)){
```

```
      #Check for duplicate records based on the primary key
   existing_ids <- dbGetQuery(my_connection,
  sprintf("SELECT customer_id FROM CUSTOMERS WHERE customer_id = '%s'"
          ,   df$customer_id[i]))
    if(nrow(existing_ids) > 0) {
      cat(sprintf("Skipping duplicate entry for customer_id: %s\n"
                  , df$customer_id[i]))
      next
    }

    insert_query <- sprintf("INSERT INTO CUSTOMERS (customer_id, first_name
    , last_name, username, gender, date_of_birth, email, phone, street_name
    , city, country, zip_code, account_created_date, premium_subscription)
    VALUES ('%s', '%s', '%s', '%s', '%s', '%s', '%s', '%s', '%s', '%s', '%s'
    , '%s', '%s', %d)",
    df$customer_id[i], df$first_name[i], df$last_name[i], df$username[i]
    , df$gender[i], df$date_of_birth[i],df$email[i], df$phone[i]
    , df$street_name[i], df$city[i], df$country[i], df$zip_code[i]
    , df$account_created_date[i], df$premium_subscription[i])
    tryCatch({
    dbExecute(my_connection, insert_query)
      cat(sprintf("Successfully inserted row: %d\n", i))
    }, error = function(e) {
      cat(sprintf("Error in inserting row: %d, Error: %s\n", i, e$message))
    })
      }

      # Close the database connection
    dbDisconnect(my_connection)
}

for(file in customer_files) {
  df <- readr::read_csv(file)
  ingest_customer_data(df)

}
```

```
                customer_id first_name last_name     username gender
1  01HQZS38KRC38NFNQR9QF1MTBZ       Poul  Jellings  pjellingsdv   Male
2  01HQZS38KT99V41AM8FFX4GZH7       Rolf   Crocket   rcrocketdw   Male
3  01HQZS38KW6A30TWWP40YR785F     Rockey   Lapwood   rlapwooddx   Male
4  01HQZS38KY9JB7X0RFWGEQESF5      Junia    Bayles    jbaylesdy Female
```

```
5  01HQZS38M0RSRWM1K83TZFG06K     Sydney Gillhespy sgillhespydz   Male
6  01HQZS38M3KZFS9R4CYZ8F2QNY     Johnny   Tidbold   jtidbolde0   Male
7  01HQZS38M5ZTYQRT6KQW75RQTS     Edward Strethill estrethille1  Other
8  01HQZS38M7XNA31ACXPJBC78ME       Walt Goulborne wgoulbornee2   Male
9  01HQZS38M9XY7AN2TSG9KTAARY     Bertie    Ratter    brattere3   Male
10 01HQZS38MC1ZX8SFB5WR3V2H66   Gerianne Meininger gmeiningere4 Female
   date_of_birth                        email        phone
1     1992-12-11 pjellingsdv@reverbnation.com 277-129-0314
2     1990-04-21        rcrocketdw@uol.com.br 755-108-4849
3     1992-09-20       rlapwooddx@latimes.com 563-846-2198
4     1999-02-13          jbaylesdy@hc360.com 809-987-6451
5     1990-05-15      sgillhespydz@cdbaby.com 881-340-2239
6     1990-08-04      jtidbolde0@china.com.cn 634-193-3056
7     1998-03-14       estrethille1@goo.ne.jp 716-684-1496
8     1997-02-01         wgoulbornee2@ihg.com 285-539-0816
9     1990-11-13      brattere3@bloomberg.com 455-678-8574
10    1992-10-18       gmeiningere4@amazon.de 302-279-5654
                  street_name       city        country zip_code
1       3 Stone Corner Street   Aberdeen United Kingdom     AB39
2           547 Fordem Avenue    Glasgow United Kingdom       G4
3               97 4th Avenue  Edinburgh United Kingdom      EH9
4             3922 Vahlen Way Birmingham United Kingdom      B12
5          60256 Russell Park  Liverpool United Kingdom      L74
6             5 Huxley Center      Upton United Kingdom     DN21
7              24 Ramsey Road    Kirkton United Kingdom     KW10
8             474 Lunder Lane    Wootton United Kingdom      NN4
9  4691 Weeping Birch Parkway     London United Kingdom     SW1E
10         15 Hanover Terrace   Brampton United Kingdom     NR34
   account_created_date premium_subscription
1            2023-04-01                    0
2            2023-12-15                    0
3            2023-11-30                    0
4            2023-07-09                    0
5            2023-06-08                    1
6            2024-02-26                    1
7            2023-04-12                    0
8            2024-03-03                    1
9            2023-09-12                    1
10           2024-01-26                    1
```

PRODUCT_CATEGORY

This code is about adding new product categories to an e-commerce database. Here's a sim-

plified breakdown:

1. Connecting to Database: It starts by connecting to the e-commerce database to prepare for adding new information.
2. Checking the List: The code expects each product category data to have two specific pieces of information: a unique category ID and the category name. It checks to make sure this data is present before proceeding.
3. Ensuring Completeness: It makes sure that none of the required details (category ID and name) are missing for any of the categories.
4. Adding Categories: For each category, it first checks if the category ID already exists in the database to avoid duplicates. If the category is new, it adds the category ID and name into the database.
5. Handling Issues: If there's a problem adding a category (like a technical glitch), it will let you know without stopping the whole process.
6. Wrapping Up: Once all the categories from the file have been checked and added, it closes the connection to the database.

This process repeats for each file in a list of category files, ensuring all new product categories are added to the database efficiently and correctly.

```
ingest_product_category <- function(df) {

  my_connection <- RSQLite::dbConnect(RSQLite::SQLite()
                                      , "../database/ecommerce_database_v1.db")

  expected_cols <- c("category_id", "cat_name")
  if (!check_column_match(df, expected_cols)) return(FALSE)

  # Check for null values in NOT NULL columns
  required_columns <- c("category_id", "cat_name")
  df <- df[!rowSums(is.na(df[required_columns])) > 0, ]

  # Insert validated data into the database
  for(i in 1:nrow(df)){
    # Check for duplicate records based on the primary key
    existing_ids <- dbGetQuery(my_connection, sprintf("SELECT category_id
            FROM PRODUCT_CATEGORY WHERE category_id = '%s'", df$category_id[i]))
    if(nrow(existing_ids) > 0) {
      cat(sprintf("Skipping duplicate entry for category_id: %s\n"
                  , df$category_id[i]))
      next
    }
```

```
    insert_query <- sprintf("INSERT INTO PRODUCT_CATEGORY
                            (category_id, cat_name) VALUES ('%s', '%s')",
                            df$category_id[i], df$cat_name[i])
    tryCatch({
      dbExecute(my_connection, insert_query)
      cat(sprintf("Successfully inserted row: %d\n", i))
    }, error = function(e) {
      cat(sprintf("Error in inserting row: %d, Error: %s\n", i, e$message))
    })
  }

    dbDisconnect(my_connection)

}

for(file in category_files) {

  df <- readr::read_csv(file)
  ingest_product_category(df)
}
```

	category_id	cat_name
1	01HQZSYXN5D9YD5YEVE62CZY5T	Jewelry
2	01HQZSYXN2NFNR8NP0JDJJ4EGE	Music
3	01HQZSYXN3Y1HWZHXWRT8QBN1F	Clothing
4	01HQZSYXN8GVDME3KSR2V3CWSY	Home
5	01HQZSYXN9NDEKZ0KDTXG7GWAR	Baby
6	01HQZSYXN8HS73RN25WQHFRVS9	Garden
7	01HQZSYXN69EZ5NYSTKN55ABQ6	Outdoors
8	01HQZSYXN577K9HSBRRVY2QSMT	Kids
9	01HQZSYXN7EQ2BMKM5RZH0274J	Automotive
10	01HQZSYXN28M6P8R3N3Y74SSF1	Books
11	01HQZSYXN6Y7B8FZAJHW0AM6PC	Electronics
12	01HQZSYXN4ED4TEE0YBDZT4KX9	Industrial
13	01HQZSYXN6CG9CR3D0B1XV5PG4	Sports
14	01HQZSYXN72AVRM73YCJRXDX41	Beauty
15	01HQZSYXN5AE7QD7WTD963ZWED	Toys
16	01HQZSYXN7W4J5MDCRENEHYDFZ	Health
17	01HQZSYXN6YFDBEX24RWT2KJ9R	Games
18	01HQZSYXN8BNNSDXSQJNTGA8W1	Tools
19	01HQZSYXN4V6QHMP8859N4NF9F	Shoes
20	01HQZSYXN1A7S9BPG7EH95906T	Computers

```
21 01HQZSYXMXFJ85AVVPHYH23XFB     Grocery
```

```
                   category_id   cat_name
1  01HQZSYXN5D9YD5YEVE62CZY5T    Jewelry
2  01HQZSYXN2NFNR8NP0JDJJ4EGE      Music
3  01HQZSYXN3Y1HWZHXWRT8QBN1F   Clothing
4  01HQZSYXN8GVDME3KSR2V3CWSY       Home
5  01HQZSYXN9NDEKZ0KDTXG7GWAR       Baby
6  01HQZSYXN8HS73RN25WQHFRVS9     Garden
7  01HQZSYXN69EZ5NYSTKN55ABQ6   Outdoors
8  01HQZSYXN577K9HSBRRVY2QSMT       Kids
9  01HQZSYXN7EQ2BMKM5RZH0274J Automotive
10 01HQZSYXN28M6P8R3N3Y74SSF1      Books
```

SUPPLIERS

This code is about adding new supplier information to an e-commerce database. It works like this:

1. Connecting: First, it sets up a connection with the database where supplier information needs to be stored.
2. Checking Requirements: The code expects each supplier's information to include an ID, name, address, phone number, and email. It makes sure these details are present and correctly formatted, especially the email.
3. Ensuring Quality: The code also checks for incomplete records, particularly making sure that each supplier has both an ID and a name.
4. Adding Suppliers: One by one, it attempts to add suppliers to the database. Before adding, it checks to ensure the supplier isn't already in the database to avoid duplicates.
5. Dealing with Problems: If there's an issue while adding a supplier, like a mistake in the data or a technical glitch, the code notes the problem but continues with the rest.
6. Finishing Up: After working through all suppliers in the list, the connection to the database is closed.

This process is repeated for each file that contains a list of suppliers, making sure all new supplier data is added systematically and correctly to the database.

```r
ingest_suppliers <- function(df) {

  my_connection <- RSQLite::dbConnect(RSQLite::SQLite()
                                      , "../database/ecommerce_database_v1.db")

  expected_cols <- c("supplier_id", "supplier_name", "supplier_address",
                     "supplier_phone", "supplier_email")
```

```
  if (!check_column_match(df, expected_cols)) return(FALSE)


  # Email format validation
  valid_email <- grepl("^[a-zA-Z0-9._%+-]+@[a-zA-Z0-9.-]+\\.[a-zA-Z]{2,}$"
                       , df$supplier_email)
  df <- df[valid_email, ]

  # Check for null values in NOT NULL columns
  required_columns <- c("supplier_id", "supplier_name")
  df <- df[!rowSums(is.na(df[required_columns])) > 0, ]

  for(i in 1:nrow(df)){
    # Check for duplicate records based on the primary key
    existing_supplier_ids <- dbGetQuery(my_connection, sprintf("SELECT
      supplier_id FROM SUPPLIERS WHERE supplier_id = '%s'", df$supplier_id[i]))
    if(nrow(existing_supplier_ids) > 0) {
      cat(sprintf("Skipping duplicate entry for supplier_id: %s\n"
                  , df$supplier_id[i]))
      next
    }

    insert_query <- sprintf("INSERT INTO SUPPLIERS (supplier_id, supplier_name
      , supplier_address, supplier_phone, supplier_email)
      VALUES ('%s', '%s', '%s', '%s', '%s')",
                            df$supplier_id[i], df$supplier_name[i],
      df$supplier_address[i], df$supplier_phone[i], df$supplier_email[i])
    tryCatch({
      dbExecute(my_connection, insert_query)
      cat(sprintf("Successfully inserted row: %d\n", i))
    }, error = function(e) {
      cat(sprintf("Error in inserting row: %d, Error: %s\n", i, e$message))
    })

  }
    dbDisconnect(my_connection)

}

for(file in suppliers_files) {

  df <- readr::read_csv(file)
```

```
  ingest_suppliers(df)

}
```

GIFT CARDS

This code is about adding new gift card information to an e-commerce database, ensuring each entry is complete and unique. Here's a simpler explanation:

1. Setting Up: It connects to the database where gift card details need to be stored.
2. Checking the Basics: The code looks for specific pieces of information for each gift card: an ID, a code, some details, and its status. If any expected information is missing, it stops the process.
3. Ensuring Completeness: It checks to make sure the essential details (ID, code, and status) aren't missing for any gift card.
4. Detail Adjustment: The code converts the 'detail' section into a numeric format, perhaps to standardize the data.
5. Adding Gift Cards: It goes through the list, adding each gift card to the database. If a gift card with the same ID already exists, it skips adding it to avoid duplication.
6. Handling Errors: If there's a problem adding a gift card (like incorrect data format or a database issue), it notes the error and moves on.
7. Finishing Up: After all the gift cards in the file have been processed, it closes the connection to the database.

This process is repeated for each file in a set of gift card files, ensuring all new gift card data is correctly added to the database.

```
ingest_gift_card_data <- function(df) {

  my_connection <- RSQLite::dbConnect(RSQLite::SQLite(),
                                      "../database/ecommerce_database_v1.db")

  expected_cols <- c("gift_card_id", "gift_card_code", "detail", "status")
  if (!check_column_match(df, expected_cols)) return(FALSE)

  # Validate 'gift_card_id' and 'gift_card_code' for null values
  required_columns <- c("gift_card_id", "gift_card_code", "status")
  df <- df[!rowSums(is.na(df[required_columns])) > 0, ]

  # Ensure 'detail' is an integer
  df$detail <- as.numeric(df$detail)

  # Insert validated data into the database
```

```
  for(i in 1:nrow(df)){
    # Check for duplicate records based on the primary key
    existing_ids <- dbGetQuery(my_connection,
                      sprintf("SELECT gift_card_id FROM GIFT_CARD WHERE
                              gift_card_id = '%s'",
                      df$gift_card_id[i]))
    if(nrow(existing_ids) > 0) {
      cat(sprintf("Skipping duplicate entry for gift_card_id: %s\n", df$gift_card_id[i]))
      next
    }

    insert_query <-
      sprintf("INSERT INTO GIFT_CARD (gift_card_id, gift_card_code, detail,
              status) VALUES ('%s', '%s', %f, '%s')",
      df$gift_card_id[i], df$gift_card_code[i], df$detail[i], df$status[i])
    tryCatch({
      dbExecute(my_connection, insert_query)
      cat(sprintf("Successfully inserted row: %d\n", i))
    }, error = function(e) {
      cat(sprintf("Error in inserting row: %d, Error: %s\n", i, e$message))
    })
  }
    dbDisconnect(my_connection)

}

for(file in gift_card_files) {

  df <- readr::read_csv(file)
  ingest_gift_card_data(df)

}
```

	gift_card_id	gift_card_code	detail	status
1	3bb1655b-9007-415c-b78a-c6c10a386882	5XT6GQ9XQ72	0.3	UNUSED
2	e644c698-5398-4f5f-a7b8-ab66bb280e9f	6H72H48TW29	0.4	USED
3	4e6f0d5a-b70a-40a3-ae31-31f9998566f9	2V17MT0KA81	0.2	UNUSED
4	bcd61684-5aaa-41c9-b524-d63bdd9a6382	1F50JV5CJ41	0.2	UNUSED
5	ee2cc879-c679-422f-bf37-a4d6f3023896	6V53UU8UH74	0.2	UNUSED
6	67eb366d-2151-4f07-8e73-8b04a8ab931d	4Q70A05EW45	0.5	USED
7	f849fbc5-91d6-453d-8948-f9ef9a443b14	5PN4CU0UJ57	0.2	USED
8	1ea8dbb3-1e1d-42f9-bdec-1ff1f13b5346	7HV0PR6FN14	0.1	USED

```
9  826e18b9-a24a-4fe2-8b45-7c8dff2d973e    3T62TX9FF49    0.5 UNUSED
10 ffd202e2-8538-420c-9a9d-989dcae6310f    7FM6UW3UG79    0.3 UNUSED
```

PRODUCTS

This code is about adding new product information to an e-commerce database. It's like checking and organizing new stock in a store. Here's a simpler breakdown:

1. Connection Setup: The code first connects to the store's database, ready to update the inventory.
2. Checking the List: It ensures each product comes with specific information: an ID, name, price, quantity in stock, category, and supplier. If any info is missing, the process halts.
3. Preparing the Stock: The quantity of each product is confirmed to be a whole number, possibly to avoid errors with partial products.
4. Ensuring Essentials: It checks that vital information (product ID, stock quantity, category, and supplier) isn't missing from any product.
5. Stocking Shelves: For each product, the code checks if that product is already in the system to avoid duplicates. If it's new, the product's details are added to the database.
6. Troubleshooting: If there's an issue adding a product, like incorrect details or a system error, the code notes the issue but keeps going.
7. Closing Time: Once all products in the list have been processed, the database connection is closed.

This process repeats for each file in a set of product files, ensuring all new products are accurately added to the store's database.

```r
ingest_products <- function(df) {

  my_connection <- RSQLite::dbConnect(RSQLite::SQLite(),
                                      "../database/ecommerce_database_v1.db")

  expected_cols <- c("product_id", "product_name", "price",
                     "stock_quantity", "category_id", "supplier_id")
  if (!check_column_match(df, expected_cols)) return(FALSE)

  # Data type checks
  df$stock_quantity <- as.integer(df$stock_quantity)

  # Check for null values in NOT NULL columns
  required_columns <-
    c("product_id", "stock_quantity", "category_id", "supplier_id")
  df <- df[!rowSums(is.na(df[required_columns])) > 0, ]
```

```
  for(i in 1:nrow(df)){
    # Check for duplicate records based on the primary key and foreign key constraints
    existing_product_ids <- dbGetQuery(my_connection,
                                       sprintf("SELECT product_id FROM PRODUCTS
                                               WHERE product_id = '%s'",
                                       df$product_id[i]))
    if(nrow(existing_product_ids) > 0) {
      cat(sprintf("Skipping duplicate entry for product_id: %s\n",
                  df$product_id[i]))
      next
    }

    # Construct and execute the insertion query
    insert_query <-
      sprintf("INSERT INTO PRODUCTS (product_id, product_name, price,
              stock_quantity, category_id, supplier_id)
              VALUES ('%s', '%s', %f, %d, '%s', '%s')",
            df$product_id[i], df$product_name[i],
            df$price[i], df$stock_quantity[i],
            df$category_id[i], df$supplier_id[i])
    tryCatch({
      dbExecute(my_connection, insert_query)
      cat(sprintf("Successfully inserted row: %d\n", i))
    }, error = function(e) {
      cat(sprintf("Error in inserting row: %d, Error: %s\n", i, e$message))
    })
  }
    dbDisconnect(my_connection)

}

for(file in products_files) {

  df <- readr::read_csv(file)
  ingest_products(df)

}
```

```
      product_id                          product_name price stock_quantity
1  5116-vjq-2956            Pampers Swaddlers Diapers    25            222
2  6718-hlo-4759      Huggies Natural Care Baby Wipes    10            424
3  2985-wrf-5782   Similac Pro-Advance Infant Formula    30            229
```

```
4  4625-mrp-9938      Philips Avent Soothie Pacifiers     5            216
5  4163-cos-4183          Bumkins Waterproof SuperBib     8            419
6  6949-zmb-6593 Aden + Anais Muslin Swaddle Blankets    20            215
7  8600-uzy-9324                    Gerber Baby Socks     5            431
8  1345-epw-6525  Nuby Mittens with Teething Surfaces     7            162
9  4488-xnr-2917            Hudson Baby Hooded Towels    12            122
10 7706-sdc-6511        Spasilk Soft Terry Washcloths     8            140
                  category_id                supplier_id
1  01HQZSYXN9NDEKZ0KDTXG7GWAR 01HQZS3CHR3Z0C3RDD0QYFT566
2  01HQZSYXN9NDEKZ0KDTXG7GWAR 01HQZS3CHZ74ZQCSDXCS7CBVAC
3  01HQZSYXN9NDEKZ0KDTXG7GWAR 01HQZS3CHX81N7E24DA6H2H5DW
4  01HQZSYXN9NDEKZ0KDTXG7GWAR 01HQZS3CHF5YHQ7PBD8T11XRG1
5  01HQZSYXN9NDEKZ0KDTXG7GWAR 01HQZS3CHWKK9ACW7KQ58MHMZ1
6  01HQZSYXN9NDEKZ0KDTXG7GWAR 01HQZS3CHWKK9ACW7KQ58MHMZ1
7  01HQZSYXN9NDEKZ0KDTXG7GWAR 01HQZS3CHZ74ZQCSDXCS7CBVAC
8  01HQZSYXN9NDEKZ0KDTXG7GWAR 01HQZS3CHR3Z0C3RDD0QYFT566
9  01HQZSYXN9NDEKZ0KDTXG7GWAR 01HQZS3CJ0MY496XC7CYHNBGTJ
10 01HQZSYXN9NDEKZ0KDTXG7GWAR 01HQZS3CHSG3EB7GENNYD7YQ2K
```

ORDER

This code is about processing new orders in an e-commerce system, Here's a simple explanation:

1. Connection Setup: First, it connects to the store's database to start updating the order records.
2. Checking the Order List: The code makes sure each order includes all the necessary information like order ID, customer ID, product ID, and so on. If something's missing, the process stops.
3. Verifying Order Details: It ensures crucial details like the order ID, the quantity of items, and the order status are present and correct for every order.
4. Processing Orders: For each order, it checks if that order already exists in the database to avoid recording it twice. It also checks if the quantity of items is valid (more than zero and a number).
5. Recording Orders: After passing the checks, each order's details are added to the database.
6. Handling Errors: If there's an issue with adding an order (like incorrect data or a technical glitch), the code notes the problem but continues with the next order.
7. Finishing Up: Once all orders have been processed, it disconnects from the database.

This way, each new order is carefully checked and recorded in the system, ensuring the database is up-to-date and accurate.

```r
ingest_orders <- function(df) {

  my_connection <- RSQLite::dbConnect(RSQLite::SQLite(),
                                      "../database/ecommerce_database_v1.db")

  expected_cols <- c("order_id", "customer_id", "product_id", "shipment_id",
                     "gift_card_id", "payment_method", "quantity",
                     "order_timestamp", "payment_timestamp", "order_status")
  if (!check_column_match(df, expected_cols)) return(FALSE)

  # Essential columns for validation
  required_columns <- c("order_id", "order_status", "quantity")
  df <- df[!rowSums(is.na(df[required_columns])) > 0, ]

  for(i in 1:nrow(df)) {
    # Check for duplicate order_id
    existing_ids <- dbGetQuery(my_connection,
                     sprintf("SELECT order_id FROM ORDERS
                             WHERE order_id = '%s'",
                     df$order_id[i]))
    if(nrow(existing_ids) > 0) {
      cat(sprintf("Skipping duplicate entry for order_id: %s\n",
                  df$order_id[i]))
      next
    }

    # Data validation for quantity
    if(!is.numeric(df$quantity[i]) || df$quantity[i] <= 0) {
      cat(sprintf("Skipping entry due to invalid quantity for order_id: %s\n",
                  df$order_id[i]))
      next
    }

    # Insert validated data into the database
    insert_query <-
      sprintf("INSERT INTO ORDERS (order_id, customer_id, product_id,
              shipment_id, gift_card_id, payment_method, quantity,
              order_timestamp, payment_timestamp, order_status)
              VALUES ('%s', '%s', '%s', '%s', '%s', '%s',
              %d, '%s', '%s', '%s')",
              df$order_id[i], df$customer_id[i], df$product_id[i],
              df$shipment_id[i], df$gift_card_id[i], df$payment_method[i],
```

```
              df$quantity[i], df$order_timestamp[i], df$payment_timestamp[i],
              df$order_status[i])
    tryCatch({
      dbExecute(my_connection, insert_query)
      cat(sprintf("Successfully inserted row: %d\n", i))
    }, error = function(e) {
      cat(sprintf("Error in inserting row: %d, Error: %s\n", i, e$message))
    })
  }
    dbDisconnect(my_connection)

}


# Assume orders_df is your DataFrame containing orders data
ingest_orders(orders_df)
```

```
   order_id                customer_id    product_id
1  ORD-0001 01HQZS38YDTF2DBFZMBDXF6WZ6 3672-agb-8683
2  ORD-0002 01HQZS3A94XFFP2XQZ3P67369X 8612-swk-4072
3  ORD-0003 01HQZS39J8GEMSNSKB3GK13V5Z 8162-ohs-2848
4  ORD-0004 01HQZS38QJBCBRXYQCFV4SN48Q 0239-sss-2251
5  ORD-0005 01HQZS39QSCH1MS4VMMD5Y6XPP 6643-jgq-7681
6  ORD-0006 01HQZS39FG5QBNT1QE1GE1RWWP 1439-jfo-9022
7  ORD-0007 01HQZS39HKBGAEMPSZC1KEJ5MA 2985-wrf-5782
8  ORD-0008 01HQZS39FVYFWSK9DP5DE94NX0 6265-dqm-3061
9  ORD-0009 01HQZS38QJBCBRXYQCFV4SN48Q 1619-lcu-9571
10 ORD-0010 01HQZS38VF3SMDQQ3S5ZVR8865 1619-lcu-9571
                           gift_card_id payment_method quantity order_timestamp
1  3014edd1-7db0-4e6e-b19d-5bc9ff355b9c         PayPal        4      2024-02-01
2  fa8f2b6f-ffe4-4dbe-bd5e-1421b5ce15e4             NA        1      2024-02-05
3  15ab6b33-e9db-485e-b0bd-b51fb10e9ae7      Gift Card        3      2024-02-02
4  623c535f-602f-48e6-a5a7-a5802586c06b      Gift Card        1      2024-02-19
5  a8308354-588c-4f16-b299-a5b5aa589095    Credit Card        1      2024-02-20
6  b9b821ad-27f0-436c-925c-0a9156494a18    Credit Card        4      2024-02-01
7  e6940482-ce67-4558-b807-abcd736db07e     Debit Card        5      2024-02-17
8  2ae5c52e-6622-45d4-8ae0-7ea774992504             NA        3      2024-02-04
9  19fff31f-57b0-4f45-a083-c311054077ce    Credit Card        1      2024-02-22
10 98684120-6826-459f-b36a-0d42963599e4    Credit Card        5      2024-02-04
     payment_timestamp     order_status shipment_id
1  2024-02-02 18:00:00          Shipped   SHIP00295
2  2024-02-05 03:00:00  Pending Payment          NA
```

```
3  2024-02-03 04:00:00       Processing   SHIP00496
4  2024-02-19 09:00:00        Delivered   SHIP00130
5  2024-02-21 23:00:00 Out for Delivery   SHIP00643
6  2024-02-03 13:00:00          Shipped   SHIP00420
7  2024-02-19 05:00:00        Cancelled          NA
8  2024-02-05 03:00:00  Pending Payment          NA
9  2024-02-23 04:00:00        Cancelled          NA
10 2024-02-06 01:00:00        Delivered   SHIP00235
```

SHIPMENTS

This code operates as a data ingestion module for a logistics system, systematically validating and storing each shipment's metadata within the organization's database:

1. Connecting: It links to the database to start processing shipments.
2. Checking: It verifies each shipment has an ID and status before filing.
3. Filing: For each shipment, it checks for duplicates, then files its dispatch and delivery details, along with its status.
4. Handling Issues: If there's a filing error, it's noted, but the process continues.
5. Wrapping Up: After all shipments are filed, it secures the database connection.

This ensures the shipment records are consistently updated and accurate.

```r
ingest_shipment_data <- function(df) {

  my_connection <- RSQLite::dbConnect(RSQLite::SQLite()
                                      , "../database/ecommerce_database_v1.db")
  # Validate 'shipment_id' and 'status' for null values
  required_columns <- c("shipment_id", "status")
  df <- df[!rowSums(is.na(df[required_columns])) > 0, ]


  # Insert validated data into the database
  for(i in 1:nrow(df)){
    # Check for duplicate records based on the primary key
    existing_ids <- dbGetQuery(my_connection, sprintf("SELECT shipment_id FROM SHIPMENT WHERE
    if(nrow(existing_ids) > 0) {
      cat(sprintf("Skipping duplicate entry for shipment_id: %s\n", df$shipment_id[i]))
      next
    }

    insert_query <- sprintf("INSERT INTO SHIPMENT (shipment_id, dispatch_timestamp, delivered
                            df$shipment_id[i], df$dispatch_timestamp[i], df$delivered_timesta
```

```
    existing_ids <- dbGetQuery(my_connection
        , sprintf("SELECT shipment_id FROM SHIPMENT WHERE shipment_id = '%s'",
                  df$shipment_id[i]))
    if(nrow(existing_ids) > 0) {
      cat(sprintf("Skipping duplicate entry for shipment_id: %s\n"
                  , df$shipment_id[i]))
      next
    }

    insert_query <- sprintf("INSERT INTO SHIPMENT (shipment_id,
                        dispatch_timestamp, delivered_timestamp, status)
                        VALUES ('%s', '%s', '%s', '%s')",
                            df$shipment_id[i], df$dispatch_timestamp[i]
                            , df$delivered_timestamp[i], df$status[i])
    tryCatch({
      dbExecute(my_connection, insert_query)
      cat(sprintf("Successfully inserted row: %d\n", i))
    }, error = function(e) {
      cat(sprintf("Error in inserting row: %d, Error: %s\n", i, e$message))
    })
  }
    dbDisconnect(my_connection)

}

ingest_shipment_data(shipment_df)
```

	shipment_id	dispatch_timestamp	delivered_timestamp	status
1	SHIP00295	2024-03-14	NA	In Transit
2	SHIP00496	NA	NA	Ready for Dispatch
3	SHIP00130	2024-02-20	2024-03-02	Delivered
4	SHIP00643	2024-03-10	NA	Out for Delivery
5	SHIP00420	2024-03-14	NA	In Transit
6	SHIP00235	2024-02-04	2024-02-16	Delivered
7	SHIP00887	2024-03-14	NA	In Transit
8	SHIP00904	2024-03-14	NA	In Transit
9	SHIP00658	2024-03-14	NA	In Transit
10	SHIP00900	2024-03-14	NA	In Transit

2.3.1 Check Referential Integrity

ORDERS Table

These code snippets act as integrity checks for the "ORDERS" table, verifying links to "CUSTOMERS," "PRODUCTS," "GIFT_CARD," and "SHIPMENT" tables:

1. Customer ID Check: Validates that each customer ID in orders corresponds to an entry in the customer table, flagging any discrepancies.
2. Product ID Check: Ensures each product ID in orders matches an item in the product table, highlighting any nonexistent product references.
3. Gift Card ID Check: Confirms gift card IDs in orders exist in the gift card table, identifying any invalid uses.
4. Shipment ID Check: Verifies that each shipment ID in orders is present in the shipment table, detecting any unrecorded or nonexistent shipments.

These checks aim to identify and rectify database inconsistencies, maintaining the accuracy and trustworthiness of the order system.

customer_id check

```
dbGetQuery(my_connection,
           "SELECT
              DISTINCT o.customer_id as customer_id,
              c.customer_id as customer_id,
              first_name ||' '|| last_name as customer_name
           FROM ORDERS as o
           LEFT JOIN CUSTOMERS as c ON c.customer_id = o.customer_id
           WHERE c.customer_id is NULL
           ;")
```

```
[1] customer_id   customer_id   customer_name
<0 rows> (or 0-length row.names)
```

product_id check

```
dbGetQuery(my_connection,
           "SELECT
              DISTINCT o.product_id as product_id,
              p.product_id as product_id,
              product_name as product_name
           FROM ORDERS as o
           LEFT JOIN PRODUCTS as p ON o.product_id = p.product_id
```

```
            WHERE p.product_id is NULL
            ;")
```

```
     product_id product_id product_name
1 1727-bev-6294       <NA>         <NA>
2 4420-lwz-5789       <NA>         <NA>
3 7528-dit-1763       <NA>         <NA>
4 0986-ymb-9060       <NA>         <NA>
5 0228-vgx-5140       <NA>         <NA>
```

gift_card_id

```
dbGetQuery(my_connection,
            "SELECT
               DISTINCT o.gift_card_id as gif_card_id,
               g.gift_card_id,
               gift_card_code
            FROM ORDERS as o
            LEFT JOIN GIFT_CARD as g ON g.gift_card_id = o.gift_card_id
            WHERE o.gift_card_id is NULL
            ;")
```

```
[1] gif_card_id    gift_card_id   gift_card_code
<0 rows> (or 0-length row.names)
```

shipment_id

```
dbGetQuery(my_connection,
            "SELECT
               DISTINCT o.shipment_id as x,
               s.shipment_id
            FROM ORDERS as o
            LEFT JOIN SHIPMENT as s ON s.shipment_id = o.shipment_id
            WHERE o.shipment_id is NULL
            ORDER BY o.shipment_id
            ;")
```

```
[1] x           shipment_id
<0 rows> (or 0-length row.names)
```

PRODUCTS

These code snippets validate the "PRODUCTS" table, ensuring products are correctly linked to existing suppliers and categories:

1. Supplier ID Check: Verifies each product's supplier ID against the "SUPPLIERS" table, flagging any mismatches which could indicate incorrect or outdated supplier links.
2. Category ID Check: Confirms each product's category ID with the "PRODUCT_CATEGORY" table, identifying any nonexistent category links, which could suggest mislabeling or missing categories.

These validations are essential for maintaining database integrity and supporting efficient inventory and order management.

supplier_id

```
dbGetQuery(my_connection,
           "SELECT
              DISTINCT p.supplier_id,
              s.supplier_id as a,
              s.supplier_name
           FROM PRODUCTS as p
           LEFT JOIN SUPPLIERS as s ON p.supplier_id = s.supplier_id
           WHERE s.supplier_id is NULL
           ORDER BY p.supplier_id
           ;")
```

```
                 supplier_id    a supplier_name
1 01HQZS3CJJMZ8VE8FSFV12394Q <NA>          <NA>
2 01HQZS3CJSA14X7CFXR9GN7HJJ <NA>          <NA>
3 01HQZS3CK7TNQY984CRWZ2YWYH <NA>          <NA>
4 01HQZS3CP6J1E2W3K754ED8TSV <NA>          <NA>
5 01HQZS3CWAANK3HMDV7OKFNRTE <NA>          <NA>
6 01HQZS3CZ808EDV2QSZ7EC6RGQ <NA>          <NA>
7 01HQZS3D2JCXJ0GKKPY6JT5RMM <NA>          <NA>
```

category_id

```
dbGetQuery(my_connection,
           "SELECT
              DISTINCT p.category_id,
              c.category_id as c,
              cat_name
```

```
            FROM PRODUCTS as p
            LEFT JOIN PRODUCT_CATEGORY as c ON c.category_id = p.category_id
            WHERE p.category_id is NULL
            ORDER BY p.category_id
            ;")
```

```
[1] category_id c           cat_name
<0 rows> (or 0-length row.names)
```

3 Data Pipeline Generation

3.1 GitHub Repository and Workflow Setup

- **.github/workflows**: This directory contains definitions for GitHub Actions workflows, which automate schema creation, data generation, validation, insertion and data analysis
- **R**: This directory is where all R scripts and code files are stored.
- **database**: Contains files related to the project's database. These include database files.
- **database_schema**: This contains SQL scripts defining the structure of the database used in the project.
- **datasets**: This directory stores data files that the R scripts would process.

3.2 GitHub Actions for Continuous Integration

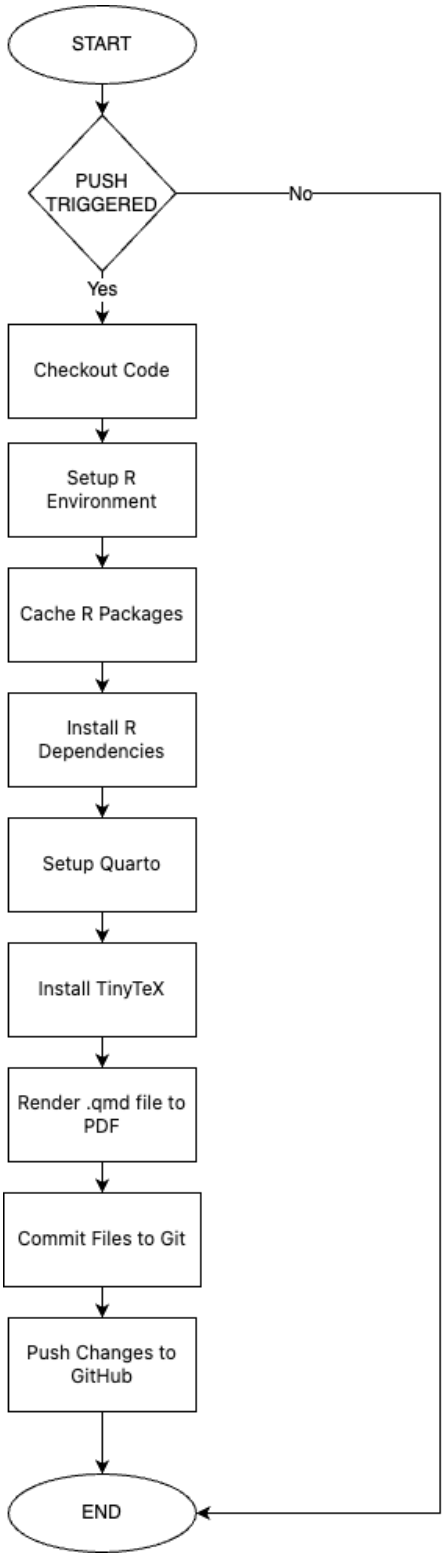


Figure 3: Github Action Workflow

4 Data Analysis and Reporting with Quarto in R

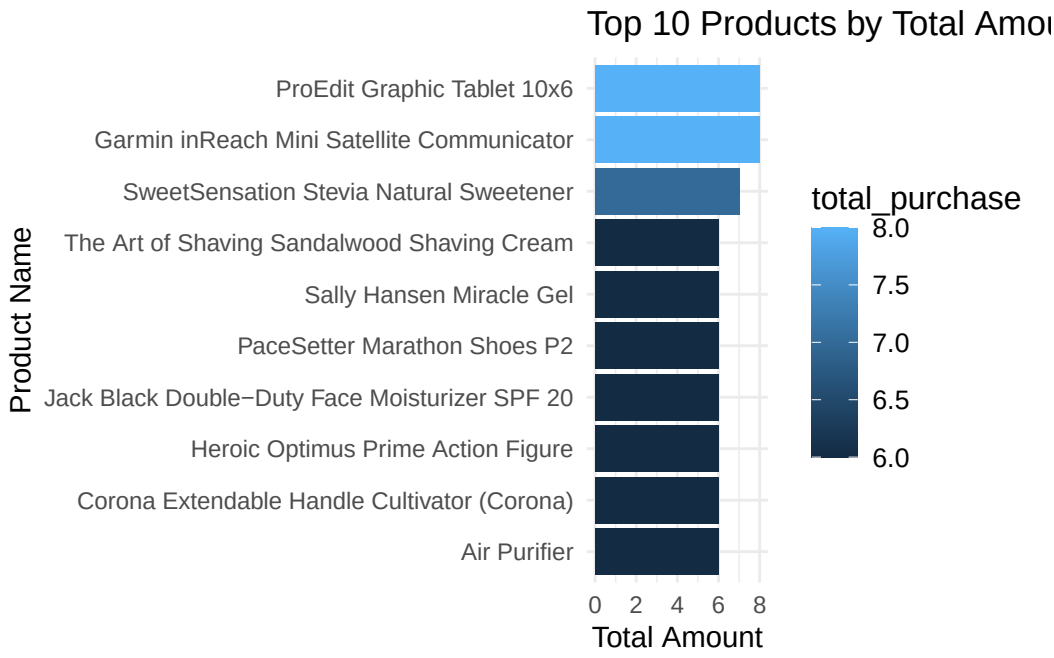
4.1 Advanced Data Analysis in R

4.2 Comprehensive Reporting with Quarto

1. Top 10 Products - Overall (Quantity)

```
# Define the SQL query
query_1 <- dbGetQuery(my_connection,
           "SELECT
              ORDERS.product_id,
              product_name,
              count(quantity) as total_purchase
           FROM ORDERS
           JOIN PRODUCTS ON ORDERS.product_id = PRODUCTS.product_id
           WHERE lower(order_status) in ('shipped','delivered')
           GROUP BY ORDERS.product_id,product_name
           ORDER BY total_purchase desc
           LIMIT 10
           ;")

# Visualize the result using ggplot2
ggplot(query_1, aes(x = reorder(product_name, total_purchase), y = total_purchase, fill = to
  geom_bar(stat = "identity", position = position_dodge()) +
  coord_flip() +
  labs(title = "Top 10 Products by Total Amount",
       x = "Product Name",
       y = "Total Amount") +
  theme_minimal() +
  theme(legend.title = element_text(size = 12),
        legend.text = element_text(size = 10))
```



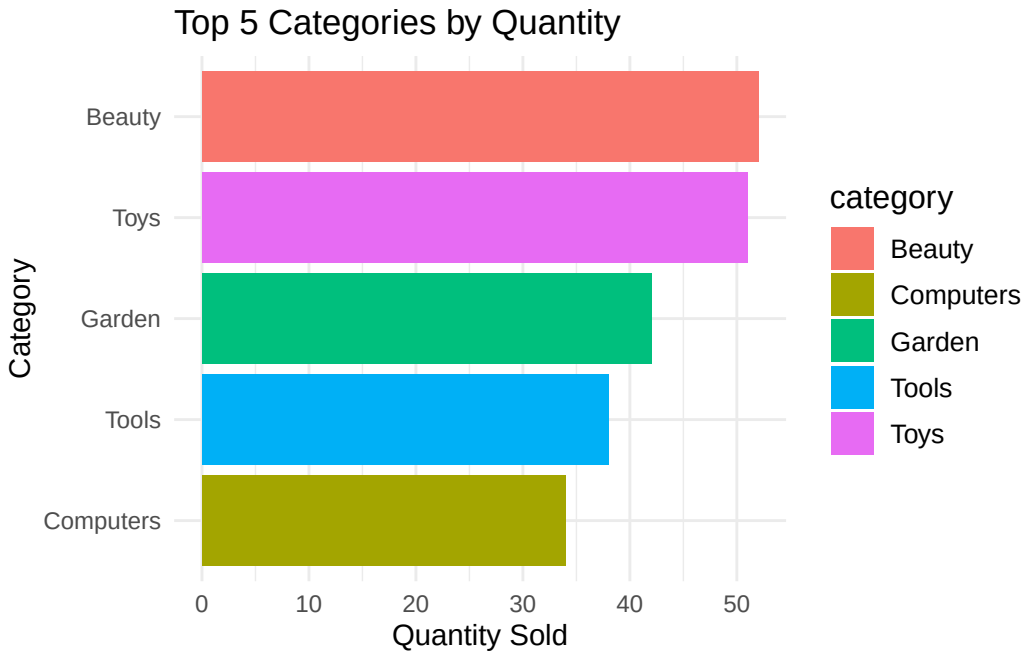
The bar chart shows the top 10 products by total sales amount. Leading the chart, the 'ProEdit Graphic Tablet 10x6' and the 'Garmin in Reach Mini Satellite Communicator' indicate strong sales, suggesting high consumer demand. The diversity of products, including computers, groceries, and other items, reflects varied consumer interests and potential market segments for focus.

2. Top 5 Categories (Quantity)

```
# SQL query to fetch top 5 categories by quantity
query_2 <- dbGetQuery(my_connection,
           "SELECT
              cat_name as category,
              count(quantity) as total_purchase
           FROM ORDERS
           JOIN PRODUCTS ON ORDERS.product_id = PRODUCTS.product_id
           JOIN PRODUCT_CATEGORY ON PRODUCTS.category_id = PRODUCT_CATEGORY.category_id
           WHERE lower(order_status) in ('shipped','delivered')
           GROUP BY cat_name
           ORDER by total_purchase desc
           LIMIT 5
           ;")

# Plot using ggplot2
ggplot(query_2, aes(x = reorder(category, total_purchase), y = total_purchase, fill = categor
```

```
  geom_bar(stat = "identity", position = position_dodge()) +
  coord_flip() +
  labs(title = "Top 5 Categories by Quantity",
       x = "Category",
       y = "Quantity Sold") +
  theme_minimal() +
  theme(legend.title = element_text(size = 12),
        legend.text = element_text(size = 10))
```



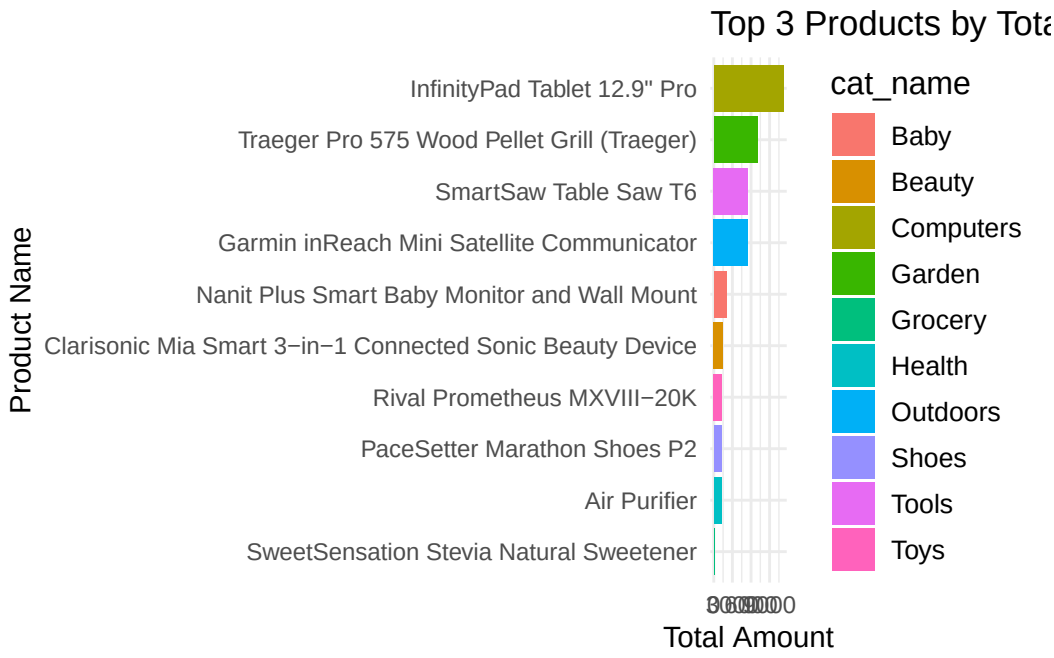
This bar chart depicts the top five product categories ranked by quantity sold. Beauty products lead, indicating high customer demand, followed by toys, which may suggest popularity or a large customer base for these items.

3. Top 3 Products across categories (Total Amount)

```
query_3 <- dbGetQuery(my_connection,
           "WITH product AS (
              SELECT
                p.product_id,
                pc.cat_name,
                p.product_name
              FROM PRODUCTS as p
              JOIN PRODUCT_CATEGORY as pc ON pc.category_id = p.category_id
```

```
            ),
            order_amount AS (
              SELECT
                o.product_id AS product_id,
                SUM(o.quantity * p.price) AS total_amount
              FROM ORDERS as o
              JOIN PRODUCTS as p ON o.product_id = p.product_id
              WHERE LOWER(o.order_status) IN ('shipped', 'delivered')
              GROUP BY o.product_id
            ),
            rnk AS (
              SELECT
                pr.cat_name,
                pr.product_name,
                oa.total_amount,
                ROW_NUMBER() OVER (PARTITION BY pr.cat_name ORDER BY oa.total_amount DESC) AS
              FROM order_amount as oa
              JOIN product as pr ON oa.product_id = pr.product_id
            )
            SELECT
              cat_name,
              product_name,
              total_amount
            FROM rnk
            WHERE rnk = 1;")

ggplot(query_3, aes(x = reorder(product_name, total_amount), y = total_amount, fill = cat_nam
  geom_bar(stat = "identity", position = position_dodge()) +
  coord_flip() +
  labs(title = "Top 3 Products by Total Amount",
       x = "Product Name",
       y = "Total Amount") +
  theme_minimal() +
  theme(legend.title = element_text(size = 12),
        legend.text = element_text(size = 10))
```



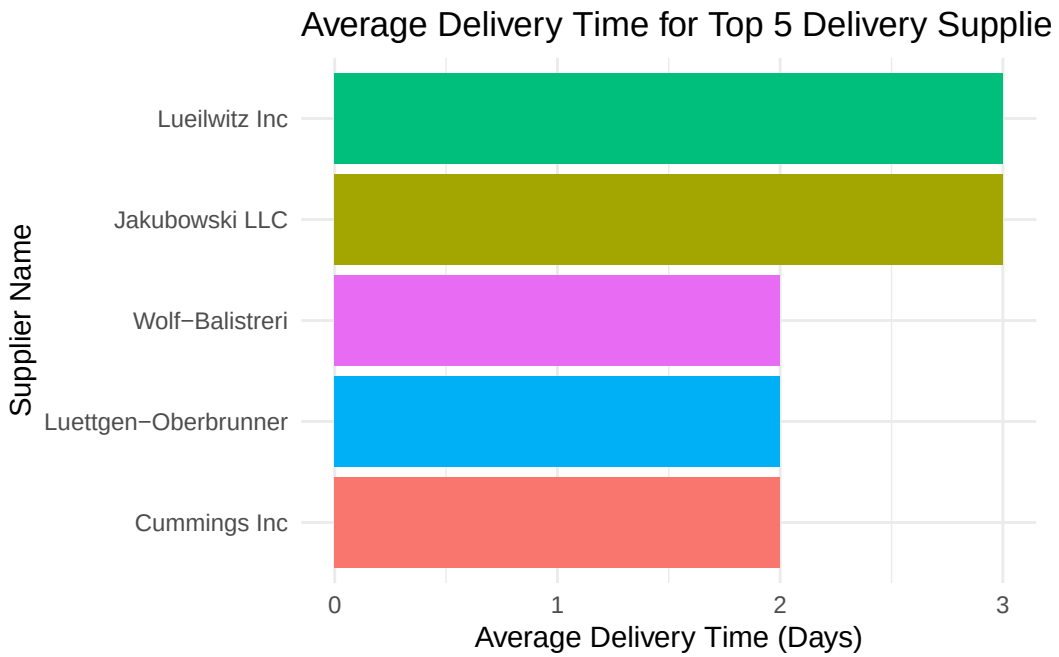
According to this bar chart, the 'InifinityPad Tablets 12.9 Pro' leads significantly, meaning a strong market preference. The 'Traeger Pro 575 Wood Pellet Grill (Traeger)' and the 'CodeMaster Development Laptop C9' follow, suggesting diverse consumer interests or needs in technology and outdoor categories.

4. Average delivery time for orders across top 5 delivery suppliers

```
# Define the SQL query for average delivery time for orders across top 5 delivery suppliers
query_4 <- dbGetQuery(my_connection,
            "SELECT
                sup.supplier_id,
                sup.supplier_name AS supplier_name,
                AVG(julianday(s.delivered_timestamp) - julianday(s.dispatch_timestamp)) AS del
            FROM SHIPMENT AS s
            JOIN ORDERS AS o ON o.shipment_id = s.shipment_id
            JOIN PRODUCTS AS p ON p.product_id = o.product_id
            JOIN SUPPLIERS AS sup ON sup.supplier_id = p.supplier_id  -- Adjusted this line
            WHERE LOWER(s.status) = 'delivered'
            GROUP BY sup.supplier_id, sup.supplier_name
            ORDER BY delivery_time, supplier_name
            LIMIT 5;")

# Plot using ggplot2
ggplot(query_4, aes(x = reorder(supplier_name, delivery_time), y = delivery_time, fill = supp
```

```
  geom_bar(stat = "identity") +
  coord_flip() +
  labs(title = "Average Delivery Time for Top 5 Delivery Suppliers",
       x = "Supplier Name",
       y = "Average Delivery Time (Days)") +
  theme_minimal() +
  theme(legend.position = "none")
```



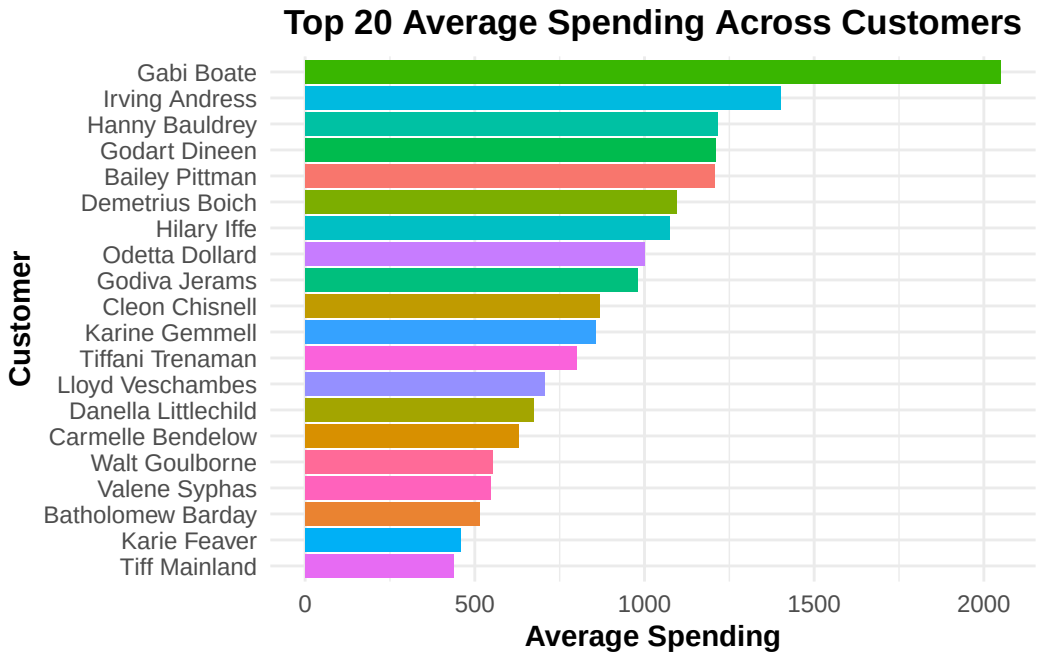
The bar chart displays the average delivery time for the five leading suppliers. Prohaska Inc. and Denesik and Sons have the longest delivery time while the other three suppliers have over 10 days for delivery, potentially suggesting an inefficiency issue.

5. Top 20 Average Spending across customers

```
# Define the SQL query
query_5 <- dbGetQuery(my_connection,
           "SELECT
              o.customer_id as customer_id,
              c.first_name ||' '|| c.last_name as customer_name,
              AVG(p.price*o.quantity) as avg_amount,
              SUM(p.price*o.quantity) as total_amount
            FROM ORDERS as o
            JOIN CUSTOMERS as c ON o.customer_id = c.customer_id
```

```
            JOIN PRODUCTS as p ON p.product_id = o.product_id
            WHERE LOWER(o.order_status) IN ('shipped', 'delivered')
            GROUP BY o.customer_id,customer_name
            ORDER BY avg_amount DESC
            limit 20
           ;")

# Plot using ggplot2
ggplot(query_5, aes(x = reorder(customer_name, avg_amount), y = avg_amount, fill = customer_n
  geom_bar(stat = "identity") +
  coord_flip() +
  labs(title = "Top 20 Average Spending Across Customers",
       x = "Customer",
       y = "Average Spending") +
  theme_minimal() +
  theme(axis.title.x = element_text(face = "bold"),
        axis.title.y = element_text(face = "bold"),
        plot.title = element_text(hjust = 0.5, face = "bold"),
        legend.position = "none")
```

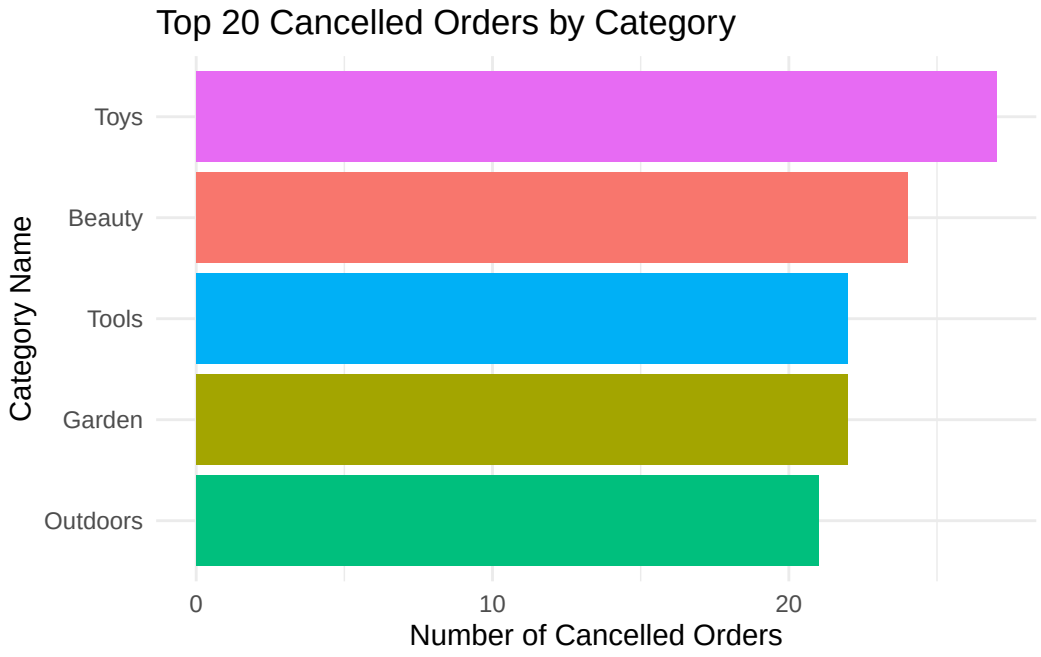


Among the top 20 customers, Gabi Boate is significantly leading, with average spending over £2000 indicating high-value transactions or frequent purchases. This suggests a potential segment of premium customers who contribute substantially to sales revenue.

6. Top 5 Categories by Most Cancellation

```
query_6 <- dbGetQuery(my_connection,
           "SELECT
              cat_name,
              COUNT(o.quantity) as total_cancelled
            FROM ORDERS as o
            JOIN PRODUCTS as p ON p.product_id = o.product_id
            JOIN PRODUCT_CATEGORY as pc on pc.category_id = p.category_id
            WHERE LOWER(order_status) = 'cancelled'
            GROUP BY cat_name
            ORDER BY total_cancelled DESC
            LIMIT 5
           ;")

# Visualization
ggplot(query_6, aes(x = reorder(cat_name, total_cancelled), y = total_cancelled, fill = cat_n
  geom_bar(stat = "identity") +
  coord_flip() +
  labs(title = "Top 20 Cancelled Orders by Category",
       x = "Category Name",
       y = "Number of Cancelled Orders") +
  theme_minimal() +
  theme(legend.position = "none")
```

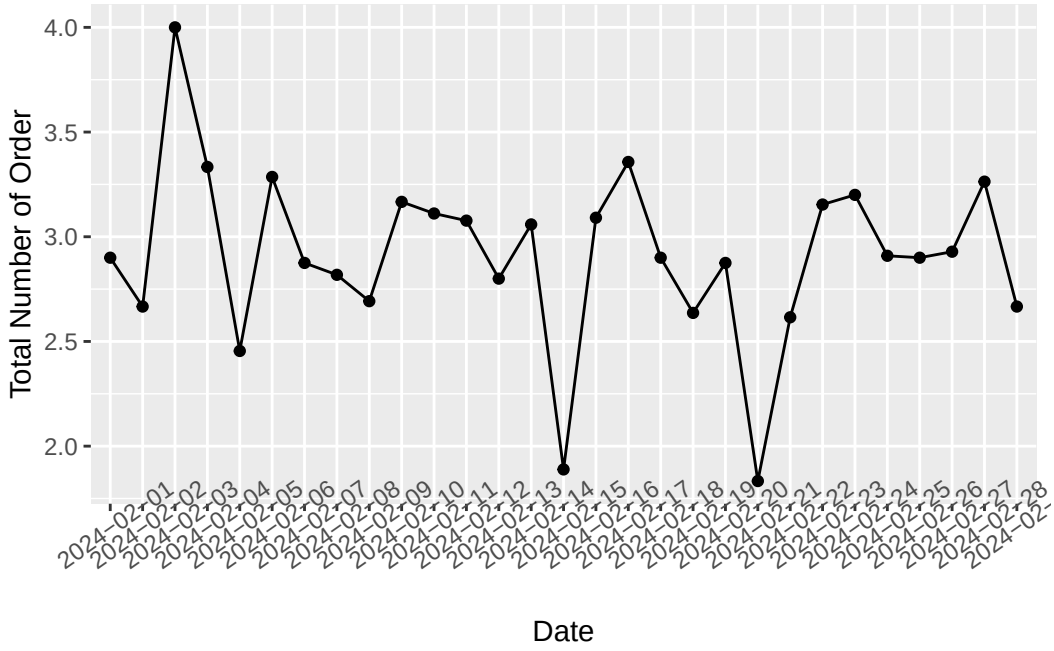


The bar plot reveals that the toy category has the highest number of cancelled orders, followed closely by the beauty category. This underscores the importance for the business to closely monitor these categories and investigate the reasons for cancellations, whether they were initiated from the buyer's side or seller's side, before proceeding with any further actions.

7. Average number of orders across time

```
query_7 <- dbGetQuery(my_connection,
           "SELECT
              order_timestamp as date,
              AVG(o.quantity) as total_order
            FROM ORDERS as o
            WHERE LOWER(order_status) IN ('shipped', 'delivered')
            GROUP BY order_timestamp
            ORDER BY date
           ;")
```

```
ggplot(query_7,aes(x=date,y=total_order,group=1))+
      geom_point(stat="identity")+
      geom_line(stat="identity")+
      labs(x="Date",y="Total Number of Order")+
        theme(axis.text.x=element_text(angle=35))
```

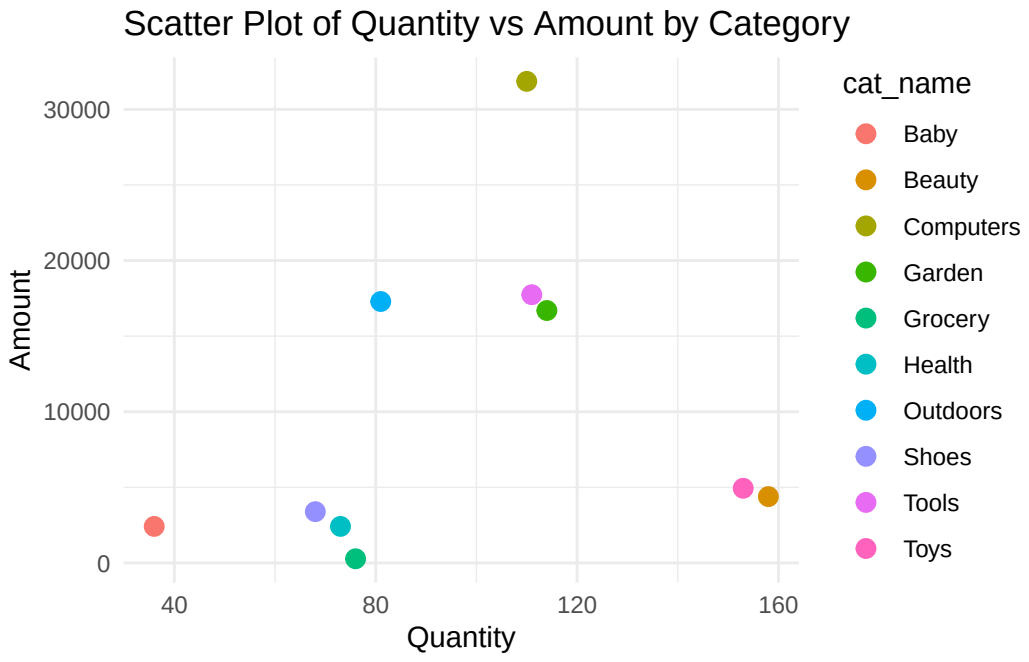


The average number of orders fluctuates significantly over time with no consistent overall trend. Peaks reach an average of 4 orders per day, while lows drop below 2 orders per day.

8. Scatter plot for revenue across quantity; color by category

```
query_8 <- dbGetQuery(my_connection,
           "SELECT
              cat_name,
              SUM(o.quantity) as quantity,
              SUM(p.price * o.quantity) as amount
            FROM ORDERS as o
            JOIN PRODUCTS as p ON p.product_id = o.product_id
            JOIN PRODUCT_CATEGORY as pc on pc.category_id = p.category_id
            WHERE LOWER(order_status) IN ('shipped', 'delivered')
            GROUP BY cat_name
           ;")

ggplot(query_8, aes(x = quantity, y = amount, color = cat_name)) +
  geom_point(size = 3) +
  theme_minimal() +
  labs(title = "Scatter Plot of Quantity vs Amount by Category",
       x = "Quantity",
       y = "Amount") +
  theme(legend.position = "right")
```



The scatter plot indicates varied sales across categories. High-value item likes Computers show substantial sales amounts, while Outdoors products suggest high revenue with lower quantities

sold. Category like Beauty exhibits highest quantities, indicating most frequent purchases of items.

```
dbDisconnect(my_connection)
```