

# Contract Packaging Metrics That Matter: On-Time In-Full (OTIF)

## Expected Outcomes

- To assess your scripting skills
- To assess your data storytelling skills
- To assess your statistical aptitude

## Instructions

1. Please complete the following assignment using Python or R.
2. Please push the assignment onto a free, publicly available repository for review (e.g. GitHub or Gitlab). The repository should include:
  - o The final code used to solve the assignment, preferably in one script
  - o A report, preferably generated using R Markdown or Jupyter Notebooks, discussing data cleaning, exploration, analysis, and results
  - o A README.md file (can be only a few lines short describing the content of your repository)
3. In the report, please include:
  - o Libraries or packages used
  - o Steps taken to clean the data
  - o Answers to the questions posted in the “Assignment” Section
  - o Any assumptions made to answer the questions
  - o Visualizations where possible
4. You are free to use any open source library or package to complete the problem.

## Datasets Description

In this assignment, you are provided with two datasets in the form of .csv files.

1. copackager\_table.csv
2. customer\_unit\_of\_measure\_conversions.csv

For table 1 (copackager\_table.csv), the columns are:

- **job.id**: unique id of packaging job
- **purchase.order.receive.date**: date (YY-MM-DD HH:MM) a purchase order from a customer is received
- **materials.availability.date**: date (YY-MM-DD HH:MM) materials needed for production are available (received from vendor)
- **production.started.date**: date (YY-MM-DD HH:MM) at which packaging job started
- **production.completed.date**: date (YY-MM-DD HH:MM) at which packaging job ended
- **quantity.produced**: quantity packaged for packaging job
- **unit.of.measure**: the unit of measure for the quantity packaged (e.g. if quantity.produced is 110 and unit.of.measure is pallets, that means that 110 pallets were produced during that job)
- **shipment.shipped.date**: date (YY-MM-DD HH:MM) at which the final packaged finished goods were shipped.
- **OTIF**: If shipments were shipped on time, then OTIF = 1, if shipment is not shipped on time, then OTIF = 0.
- **customer**: The job customer; the company that sent the purchase order in the beginning is expecting the shipment of packaged goods

For table 2 (customer\_unit\_of\_measure\_conversions.csv), the columns are:

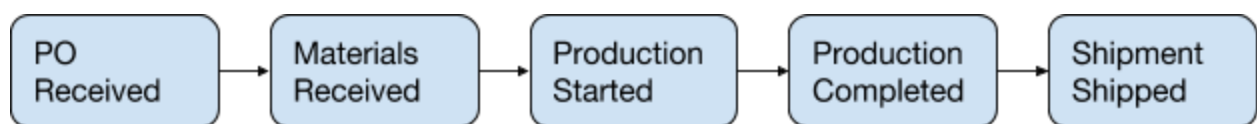
- **customer**: The job customer; the company that sent the purchase order in the beginning is expecting the shipment of packaged goods
- **cases.to.eaches.conversion**: number of eaches in a case
- **pallets.to.cases.conversion**: number of cases in a pallet
- **pallets.to.eaches.conversion**: number of eaches in a pallet

The datasets are similar to what you might expect at Nulogy.

## Background

Contract Packagers (also known as co-packers), are companies that package products for clients. Their work can include anything from adding labels on fruit cans, to building point of sale displays for cereal boxes. Household names such as Procter & Gamble and Unilever leverage the services of contract packagers for their expertise and flexibility.

A simplified traditional job life cycle for a contract packager would follow the flowchart below:



The co-packer first receives a purchase order (PO) from their customer. The PO outlines the quantity required for packaging, and the due date for the co-packer to ship the packaged product. After accepting the PO, the co-packer would potentially order materials needed (unless they were previously available). After making sure that the material is available, production can start. Production is when the actual packaging of goods happens. Production can take anywhere from less than an hour to over 16 hours. For simplicity, let us assume that the duration between Production Completed and Production Started is equivalent to one shift. After production ends, the co-packer can finally ship the finished product to the customers.

The metric that matters the most for co-packers in their relationship with customers is OTIF or On-Time In-Full. This means that the order has been fulfilled in full and delivered on time.

In the dataset, you can assume that the job is always completed in full (the packaged quantity is equal to that outlined in the PO), but the co-packer sometimes ships the product after the due date. While you don't have the due date, you do have the OTIF field which indicates whether the co-packer was on time or not (remember, the co-packer here is always in full, so if OTIF = 1, they are on time and in full, but if OTIF = 0, they are not on time but still in full).

## Assignment

Produce a report that:

1. Describes the data
2. Answers the 4 questions listed below

- **Question 1:** What is the average shift length?
- **Answer 1 example:** 8 hrs
- **Question 2:**
  - What is the change in probability of OTIF 3 days after receiving the PO vs 4 days?
  - How many days can the supplier afford to wait after receiving the PO to start production if they hope to be OTIF?
- **Answer 2 example:**
  - 10%
  - 3 days or less
- **Question 3:** Is the difference in quantity produced between P&G and Unilever statistically significant?
- **Answer 3 example:** No
- **Question 4:** Assuming everything else is constant, what is the probability of hitting OTIF if the customer was P&G?

- **Answer 4 example:** 60%

Please do not use Excel or Word. Instead, use either R or Python for data analysis and write the report using markdown. This enables us to reproduce your work.

We strongly encourage you to list your assumptions along the way. As you explore the data, you will find that there is a need to remove certain jobs because they violate assumptions listed in the “Challenge Description”. That is completely acceptable (and sometimes expected), but please make note of it and justify accordingly.

Finally, please do not embed your code in the final report. The report should be easy to read. Your audience is the Product Manager of the Data team at Nulogy.

## Final Notes

- The deliverables are:
  - Your code pushed to a public repository
  - The final report, including answers to the 4 questions
  - A README.md file
- We do not expect you to be an expert in, or have prior knowledge of, the contract packaging world.
- If we like your work, you will be requested to come in and present your analysis and thought process.
- Do your best! We care more about how you approach the problem than the final output.

Good Luck!