RUTGERS

Rutgers Business School
Newark and New Brunswick

Rutgers and AICPA Data Analytics Research Initiative

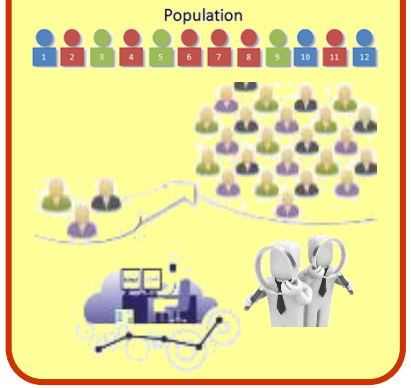
Multidimensional Audit Data Selection (MADS)

PCAOB – CARLab Meeting

BACKGROUND

Traditional sampling approach

New approach

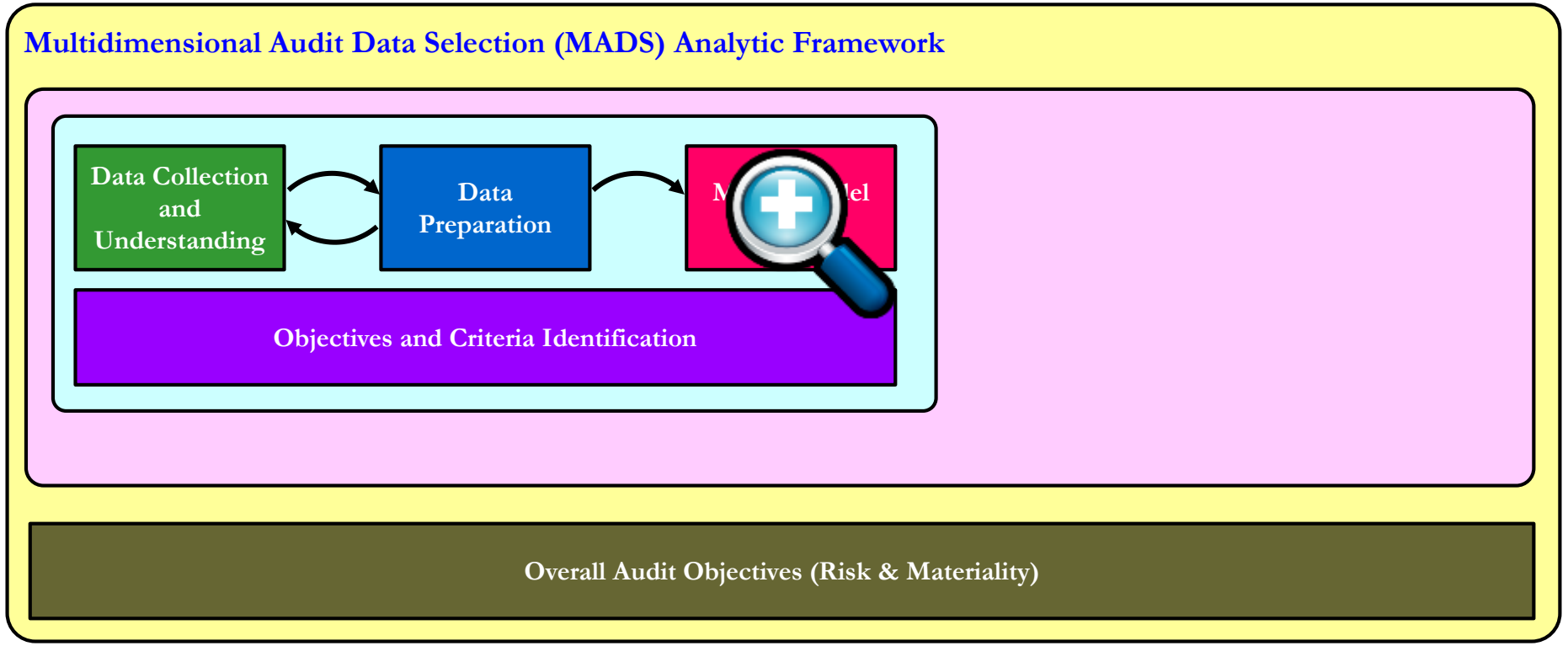


Advance in data processing ability & data analytic techniques allows auditors to evaluate the entire population instead of examining just a chosen sample.

- BUT, often generate large numbers of outliers.
- Impractical for auditors to investigate entire outliers

- Crucial to develop a method that can help auditors effectively deal with large amounts of data, but also assist them to efficiently handle a massive number of outliers.

MADS ANALYTIC FRAMEWORK



- To assist auditors identifying questionable transactions/data in performing substantive test of details
  - Developed based on prior literature and professional guidelines.
  - Modified based on comments from several panel discussions of scholars and auditing professionals.
  - Consist of six components.
- The practice of these six components is guided by the overall objectives of audit, specifically audit risk and materiality.

MADS ANALYTIC FRAMEWORK

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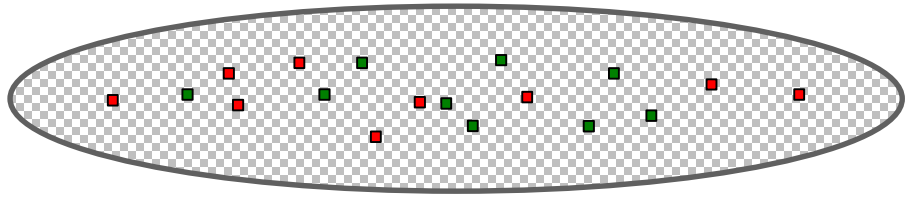
MADS Model Build Process

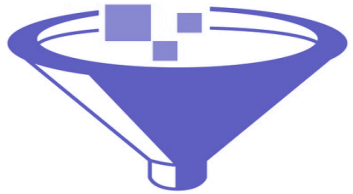
Whole Transaction Data
(Entire Population)

Step 1:
Filters for Significant Potential Risk Factors

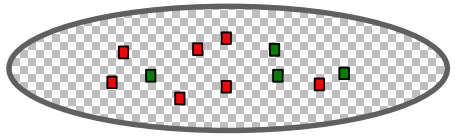
Step 1 Outputs

Step 2:
Data Analytic Techniques

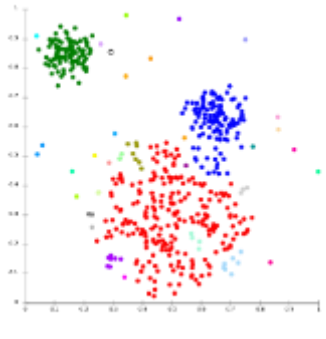


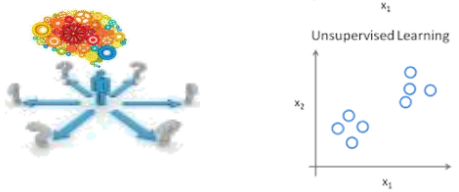


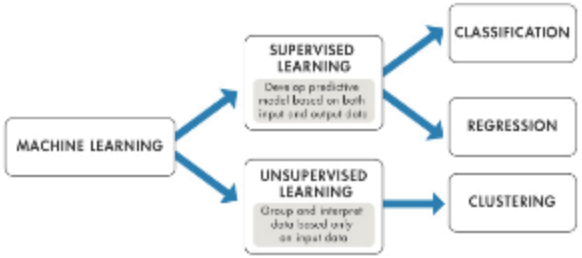
Apply a set of filters to examine significant risks (i.e., What Could Go Wrong) (e.g., duplicate payment)



- Additional Filters
- Visualization Techniques
  (e.g., scatter plots)
- Professional Judgement
  (e.g., knowledge and experiences)
- Outlier Detection Techniques
  (e.g., classification & clustering).







MADS ANALYTIC FRAMEWORK

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MADS Model Build Process

Whole Transaction Data
(Entire Population)

Step 1:
Filters for Significant Potential Risk Factors

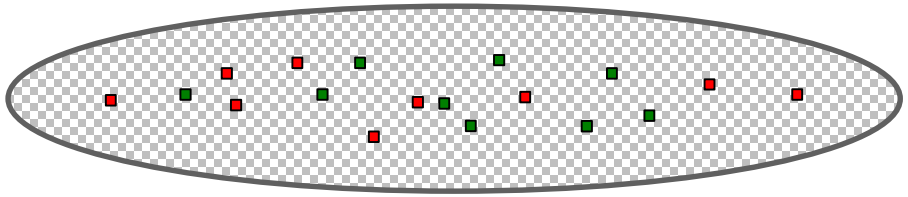
Step 1 Outputs

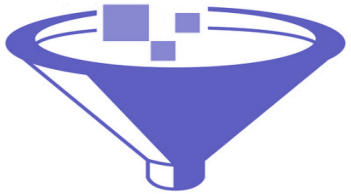
Step 2:
Data Analytic Techniques

Step 2 Outputs

Step 3:
Prioritization

Prioritized Notable Items





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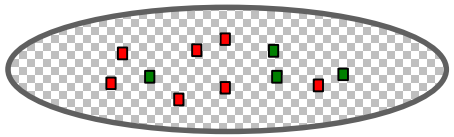

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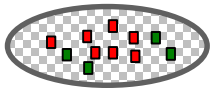
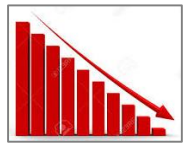
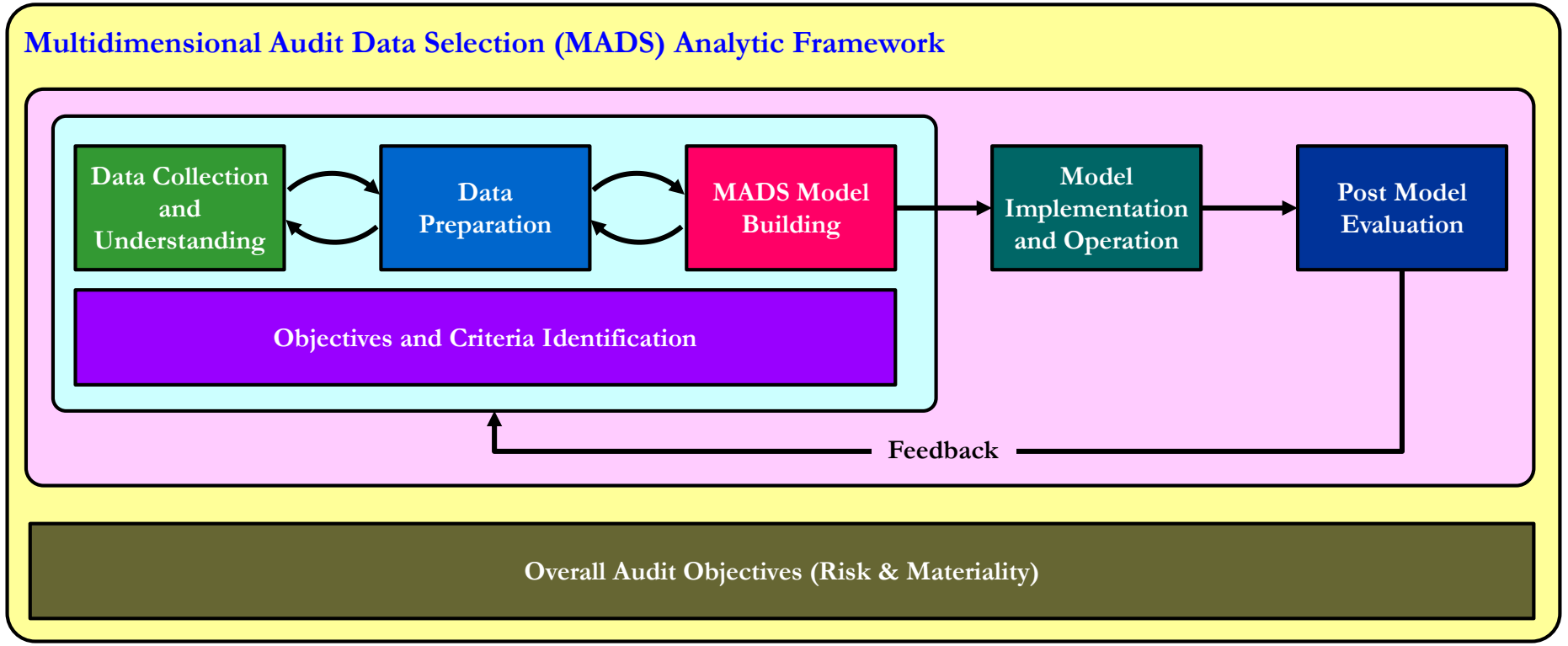




- Use professional judgement based on the importance of each step 1 filter and step 2 filter.
- Use the step 1 and/or step 2 results.
- Use a reasonable factor
  (e.g., dollar amount).

MADS ANALYTIC FRAMEWORK

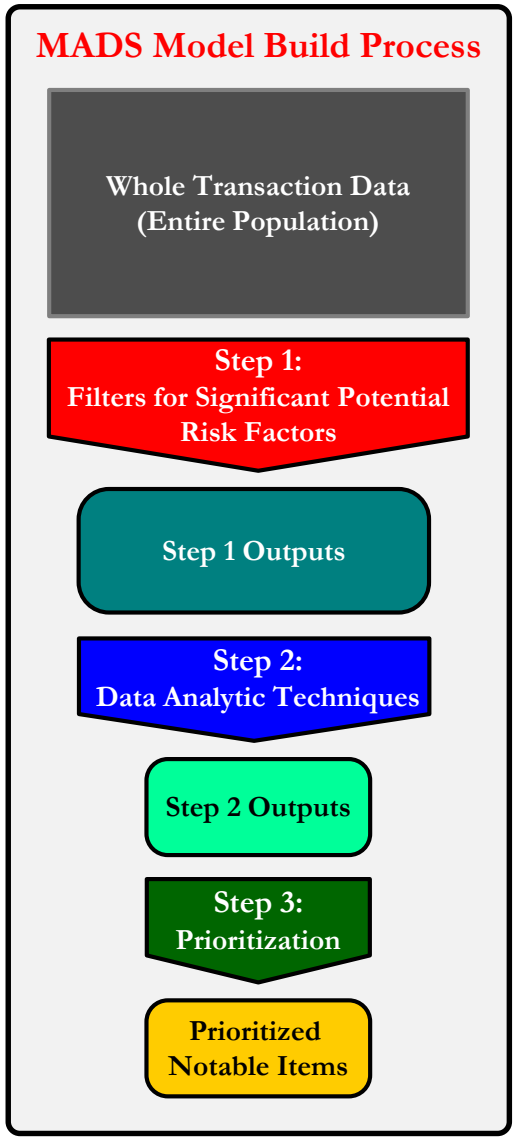


- Carry out empirical tests of whether or not the MADS process results in a more effective auditing process compared to the current sampling processes.
  - Revenue Cycle (Order-to-Cash)
  - Expenditure Cycle (Purchase-to-Pay)
  - Payroll Cycle
  - General Ledger

DATA DESCRIPTION

❖ Expenditure (Procure-to-Pay) cycle

- From Hub of Analytics Education (http://www.hubae.org)
- Bibitor LLC is a retail liquor chain company that sells wine and spirits.
  - 1 year dataset (6/21/2016 - 6/20/2017)
  - 2,291,725 records and 5,234 invoices



SUMMARY

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MADS Model Build Process

Whole Transaction Data
(Entire Population)

Step 1:
Filters for Significant Potential Risk Factors

Whole Transaction Data

2,291,725 purchase transactions records
5,234 invoices

ID	Potential Test (or Filters)
PUR-03	Identify purchases that are not properly approved (i.e., authorization limits - $250,000) by the authorizer (i.e., Chief Operating Officer).
PUR-06	Identify purchases that are received after payment.
PUR-09	Identify unusual purchases by producing exception reports of order amount/quantity that is too high (e.g., higher than percentile 95 value or greater than $5M/500 Units).
PUR-17	Identify purchases made to vendors who are not on the approved vendor list.
INV-02	Identify invoices where the order amount is different from the invoice amount.
INV-13	Identify multiple invoices at or just under approval cut-off levels (i.e., $250,000).
PAY-08	Identify payments that are made to invoices without purchase orders.
DUP-02	Identify duplicate invoices and/or amounts.

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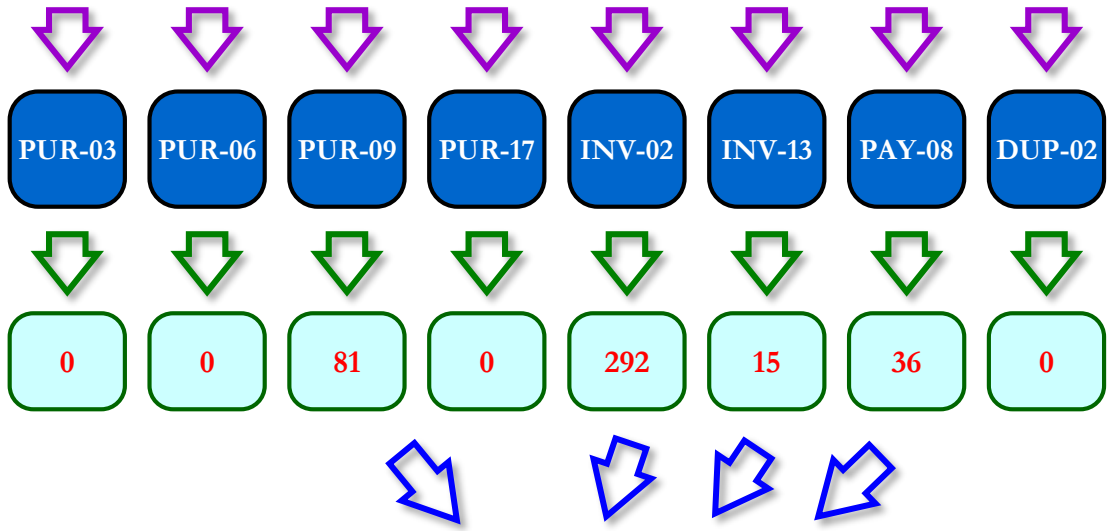
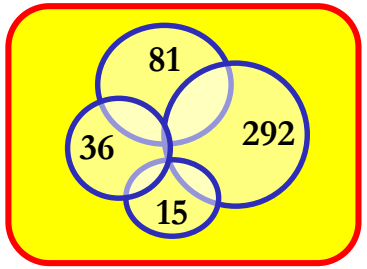


After applying step 1 filters, 384 invoices (7%) has been identified for further investigation.



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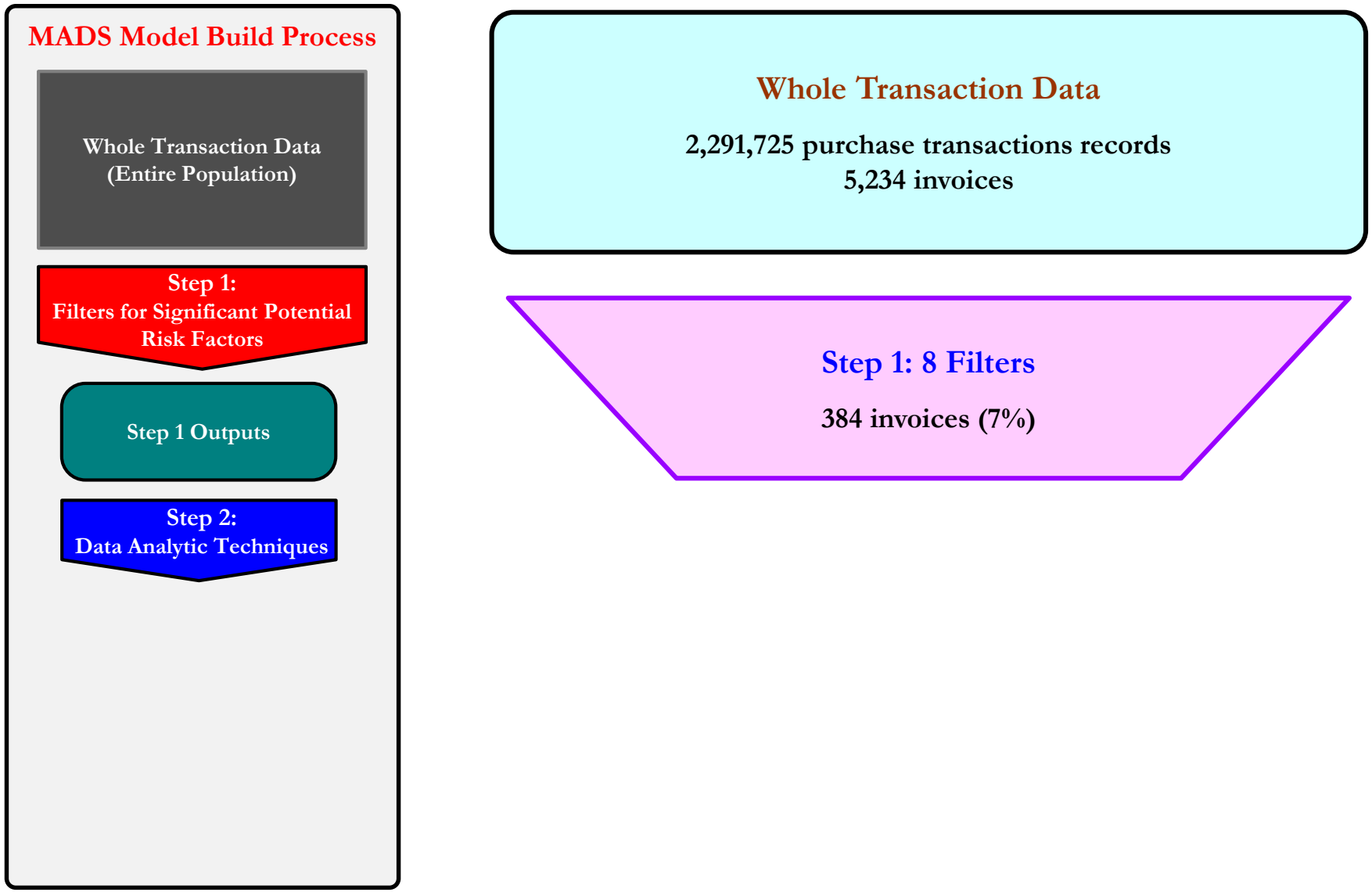
MADS Model Build Process
Whole Transaction Data
(Entire Population)
Step 1:
Filters for Significant Potential
Risk Factors
Step 1 Outputs
Step 2:
Data Analytic Techniques
Whole Transaction Data
2,291,725 purchase transactions records
5,234 invoices
Step 1: 8 Filters
384 invoices (7%)

SUMMARY

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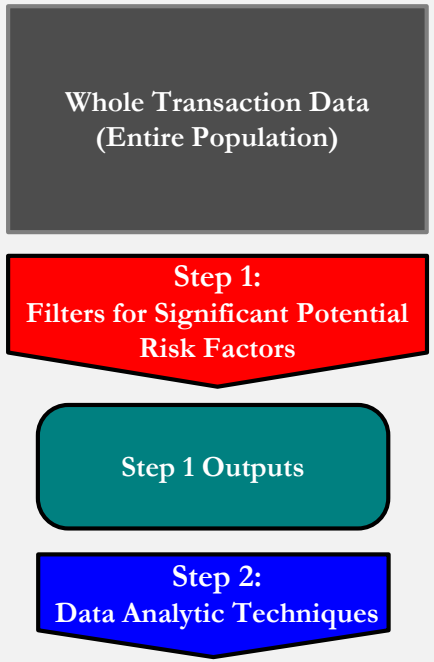
MADS Model Build Process



Whole Transaction Data

2,291,725 purchase transactions records
5,234 invoices

ID	What Could Go Wrong?	S_ID	Potential Test (or Filters)
PUR-09	Purchases are made with unusual order amount and quantity.	SUB-01	Actual price is larger than approved price.
		SUB-02	Invoice amount is significantly larger than order amount (> $100,000) *.
INV-02	Order amount does not match with invoice amount.	SUB-01	Actual price is larger than approved price.
		SUB-02	Invoice amount is significantly larger than order amount (> $100,000) *.
INV-13	Purchases are made just under approval cut-off amount.	SUB-01	Actual price is larger than approved price.
		SUB-03	Identify purchases made to vendors who are not in the approved vendor list.
PAY-08	Payments are made to invalid purchase orders.	SUB-04	Identify unusual payment without purchase orders (> $5,000) **.

* 1% of Performance Materiality
** Based on Judgement

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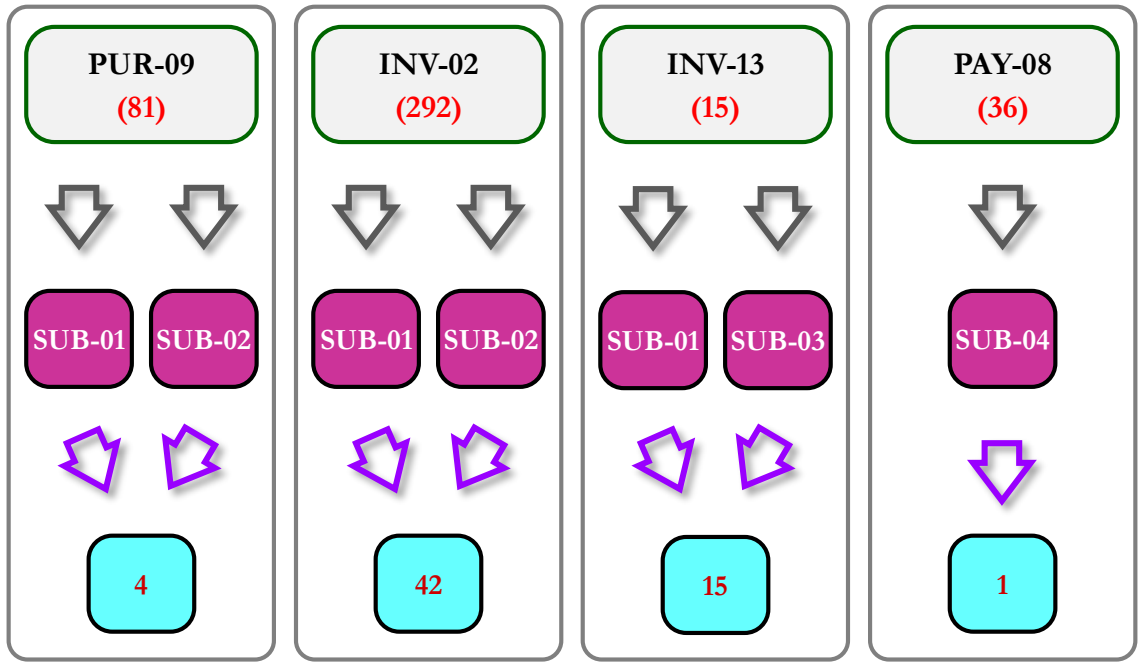
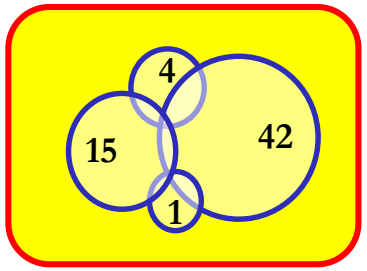
Step 1 Outputs

Step 2:
Data Analytic Techniques



After applying step 2 filters, 58 invoices (out of 384 step 1 outputs) has been detected.



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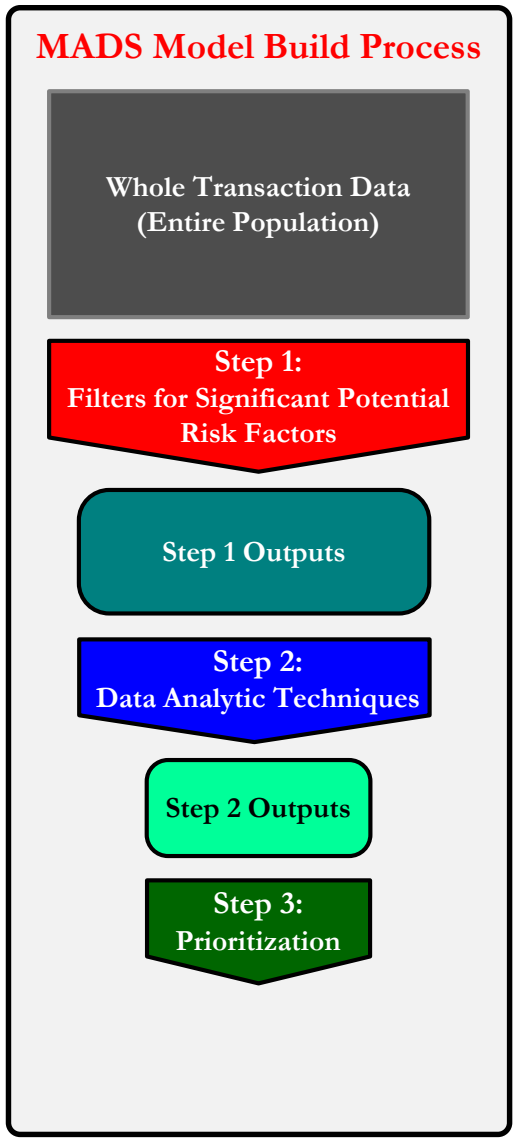
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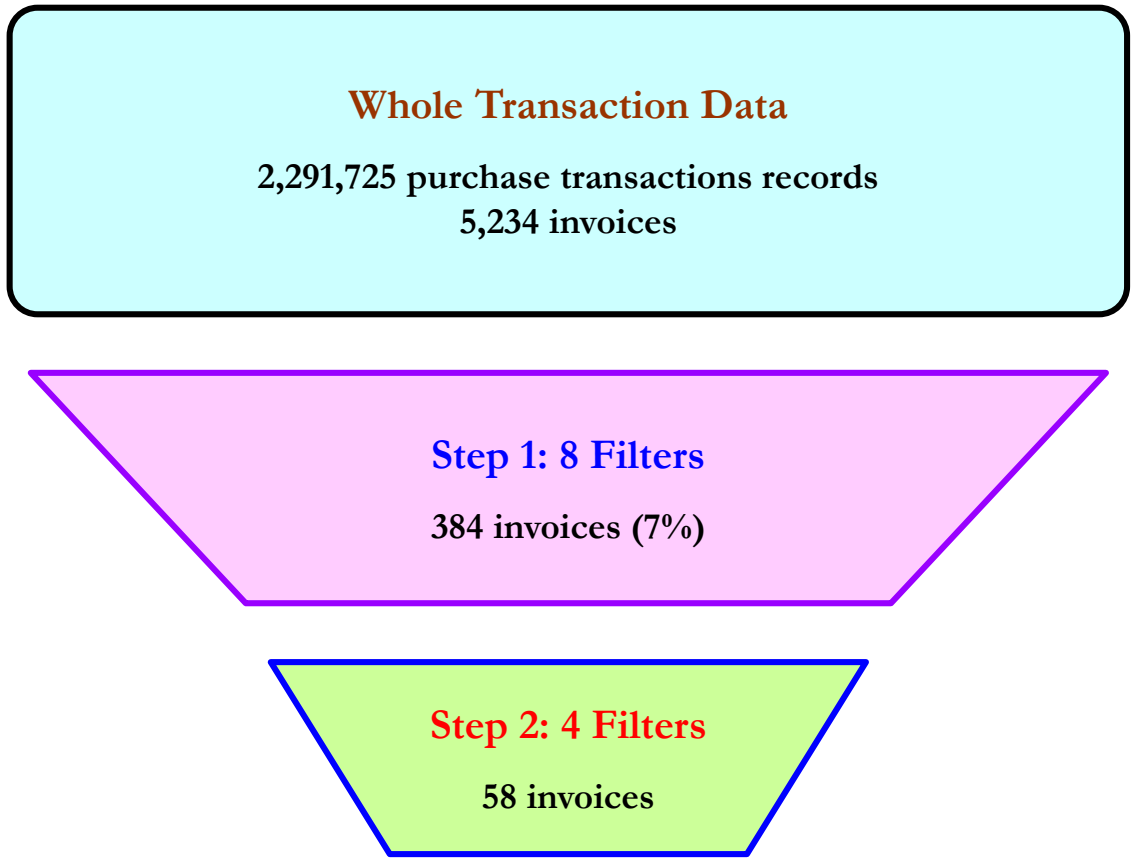
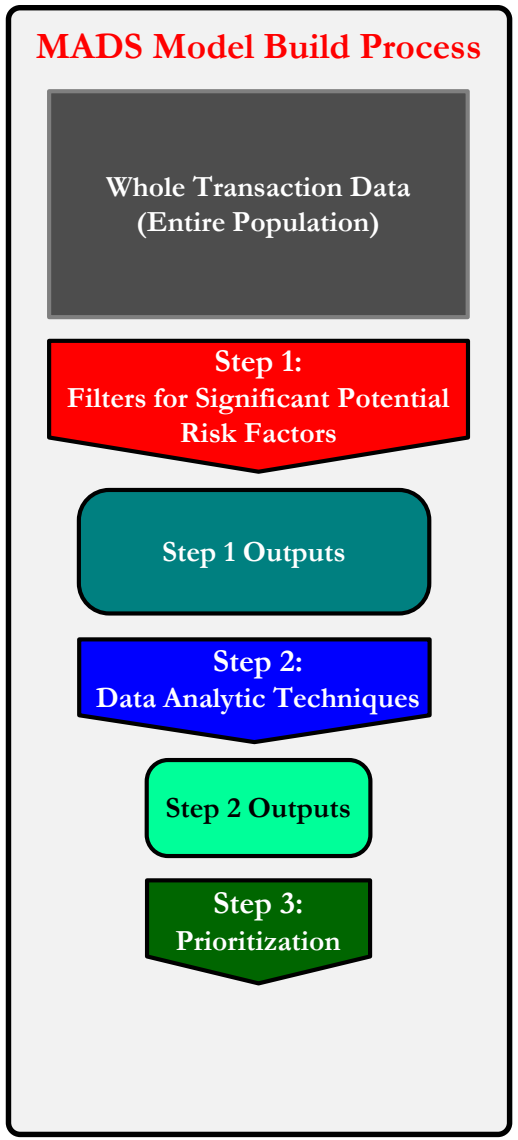
Step 1 Outputs
Step 2:
Data Analytic Techniques
Step 2 Outputs
Step 3:
Prioritization


Whole Transaction Data
2,291,725 purchase transactions records
5,234 invoices
Step 1: 8 Filters
384 invoices (7%)
Step 2: 4 Filters
58 invoices

SUMMARY



Whole Transaction Data

2,291,725 purchase transactions records
5,234 invoices

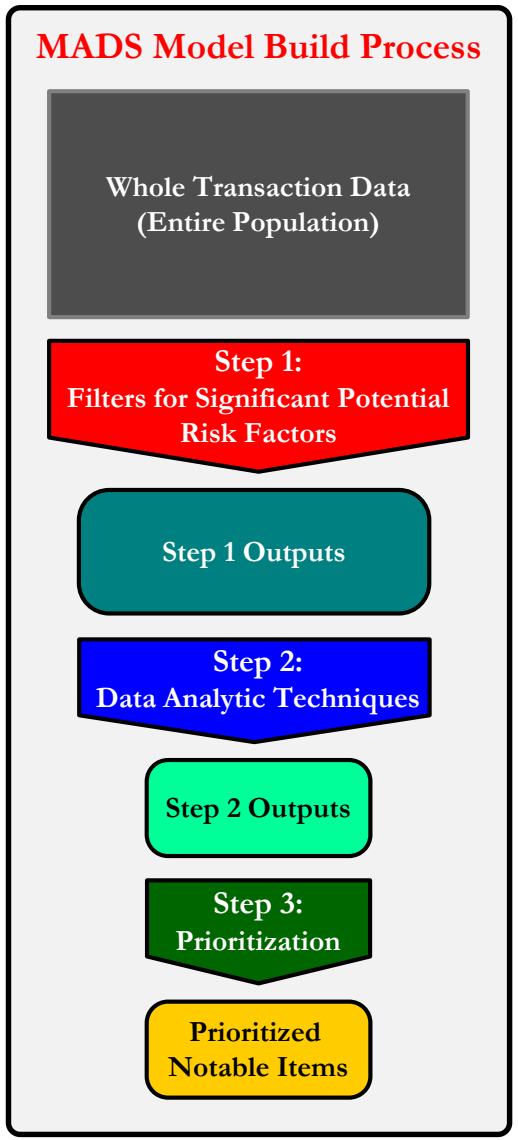
❖ Prioritization

- Use the step 1 and step 2 results.
- Example
  - Assume that invoice #273 (one of 58 notable items) has three violations in step 1 and one violation in step 2, and the dollar amount is $ 265,000.
  - Violation score will be calculated as:

$$\frac{(\text{Step 1 Violations} + \text{Step 2 Violations})}{\text{Number of Step 1 and 2 Filter Applied}} = \frac{(3+1)}{(8+2)} = .4$$

  - Suspicion score will be calculated as:
    Amount * Violation Score = 265,000 * .4 = 106,000.
- Using the suspicion score, step 2 outputs (i.e., 58 notable items) are prioritized.

SUMMARY


MADS Model Build Process
Whole Transaction Data
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Step 1:
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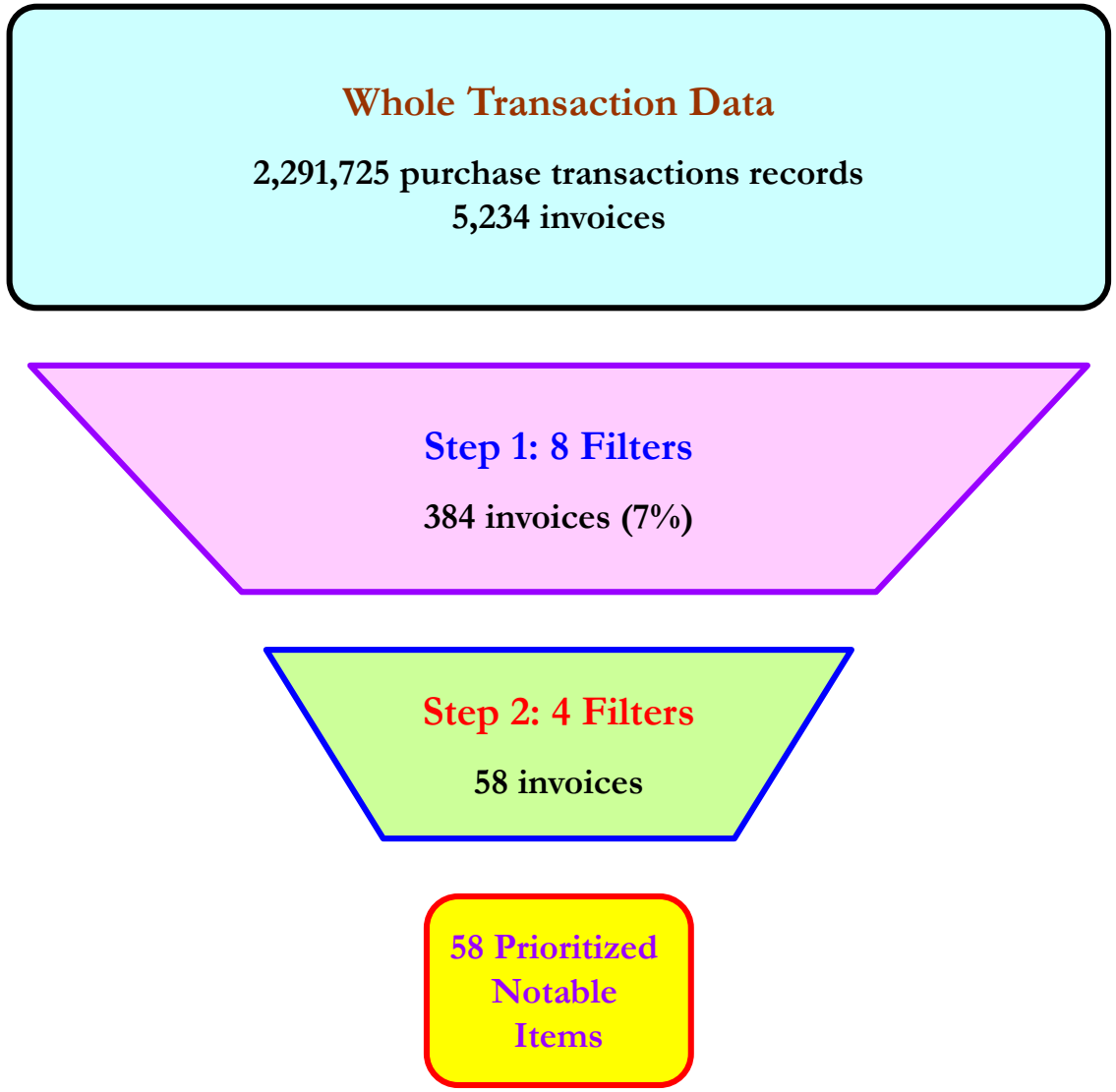
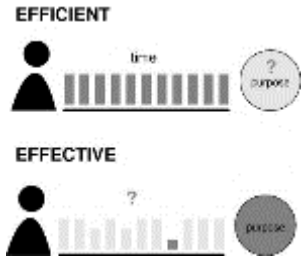
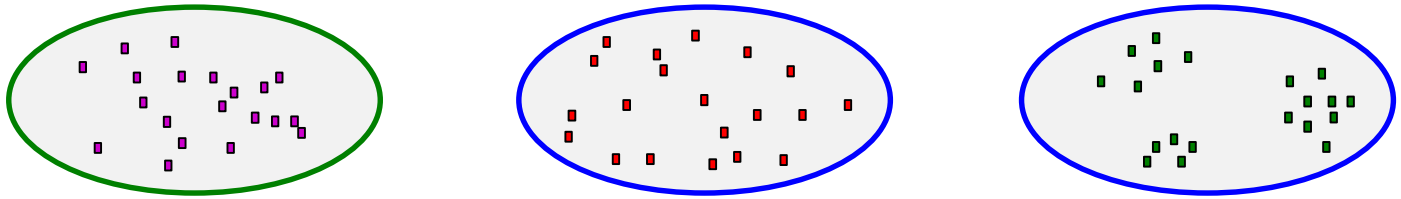
Data Analytic Techniques
Step 2 Outputs
Step 3:
Prioritization
Prioritized
Notable Items


Whole Transaction Data
2,291,725 purchase transactions records
5,234 invoices
Step 1: 8 Filters
384 invoices (7%)
Step 2: 4 Filters
58 invoices
58 Prioritized
Notable
Items

EVALUATIONS



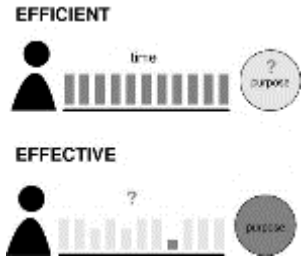
- Statistical Sampling vs. Non-statistical Sampling vs. MADS
- Two Aspects
  - Effectiveness - More suspicious items (i.e., errors) in the sample
  - Efficiency - Less sample size (?)
- Three Potential Evaluation Methods
  - Method 1: Benchmark (based on the assumption that we have already identified filters which can discover all errors in the full population)
  - Method 2: Random Transaction Changes
  - Method 3: Realistic Error Seedings by Experienced Auditors (Preferred)



Benchmark

MUS (Statistical) vs. Non-statistical vs. MADS

EVALUATIONS



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	Method 1 – Benchmark	Method 2 – Random Transaction Changes
Pro	• Use original data set (no manipulation)	• Provide error population and error items
Con	• Based on the assumption that identified filters can detect all errors • MADS is inherently more effective than traditional sampling approaches since MADS filters are a subset of identified filters.	• Change the values of original data at random. • Random value changes may not represent realistic errors.

EVALUATIONS
METHOD 1 – BENCHMARK

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❖ Benchmark

- Apply all 27 filters (8 step 1 filters + 19 additional filters).
- Assume that items filtered by 27 filters are all errors in the entire population.
- 539 (10.3%) items are identified and regarded as benchmark.

Population	$ 306,093,663
Tolerable Misstatement (75% of OM) (OM: 5% of Total Revenues)	$ 15,494,054
Expected Misstatement (1%)	$ 3,060,937
Risk of Incorrect Acceptance	10%
Sample Size	67

❖ Monetary Unit Sampling (MUS)

- Use CaseWare IDEA.
- Identify 67 items.

❖ Non-statistical Sampling

- Based on judgement, stratify items into four groups.
- All 23 large items (>= $ 1M) are included.
- 44 items are randomly selected from the arbitrarily allocated three groups (i.e., 50%, 30% and 20%).

Amount	Allocation	
>= $ 1M		23
>= $ 250,000	50%	22
>= $ 100,000	30%	13
>= 0	20%	9
Sample Size		67

❖ MADS

- All 58 notable items are selected.

EVALUATIONS

METHOD 1 – BENCHMARK

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Sampling Risk (10%)	MUS	Non-statistical	MADS	Benchmark
Sample Size	67	67	58	5,234
No. of Error Items	13 (2.4%)	23 (4.3%)	58 (10.7%)	539 (100%)
No. of Violations Detected	20 (2.6%)	35 (4.6%)	125 (16.6%)	751 (100%)

☑ More Effective

☑ More Efficient

EVALUATIONS

METHOD 1 – BENCHMARK

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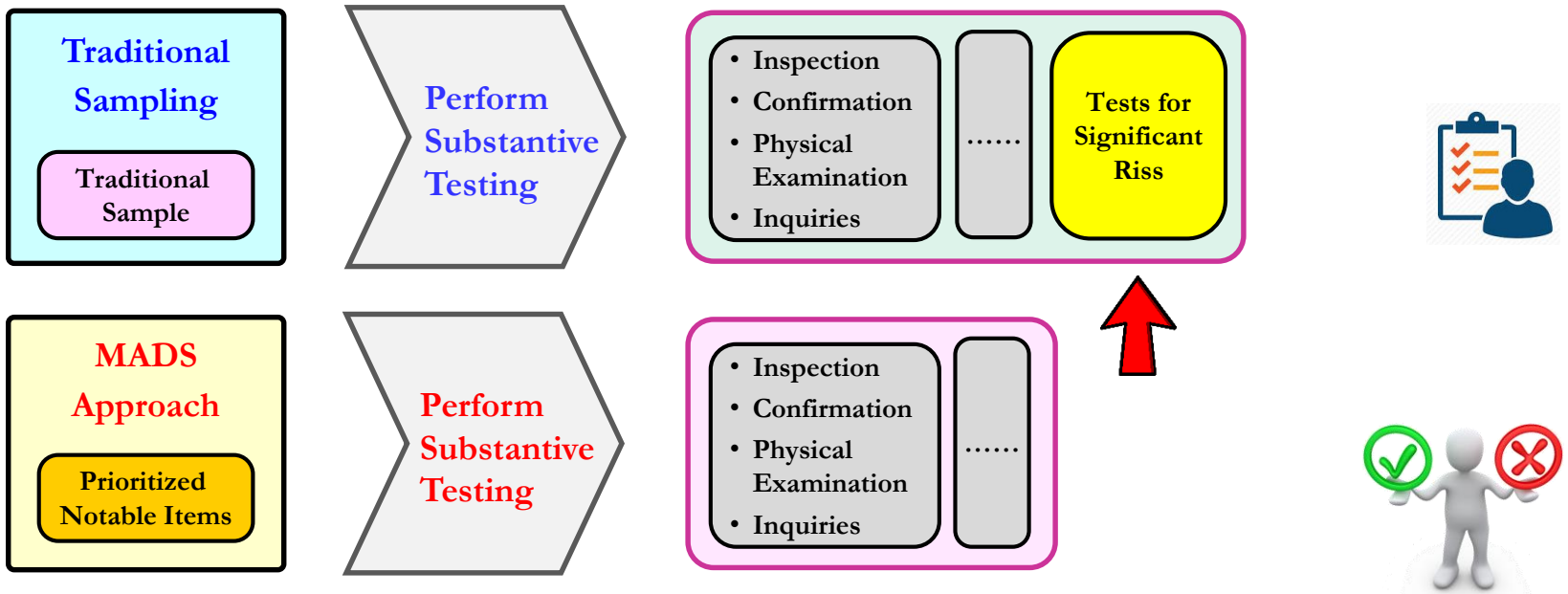

EVALUATIONS

METHOD 2 – RANDOM TRANSACTION CHANGES

- Values are randomly changed at the purchase transaction level.
  - Total number of value changes
    - 0.01% of total purchase transactions (2,291,725): 225 transactions
  - The values of amount, price, receiving date, and pay date are randomly changed.

Whole Transaction Data

2,291,725 purchase transactions records
5,234 invoices

Step 1: 8 Filters

481 invoices (9.2%)

Step 2: 4 Filters

99 invoices

99 Prioritized Notable Items

EVALUATIONS

METHOD 2 – RANDOM ERROR SEEDINGS

Sampling Risk (10%)	MUS	Non-statistical	MADS *
Sample Size	67	67	67
No. of Suspicious Items	4 (3%)	5 (3.8%)	24 (18%)
No. of Errors	133 Items		

* For comparison, choose top 67 items from 99 notable items.

☑ More Effective

☑ More Efficient

NEXT STEPS

- Different Data Analytics Techniques in Step 2 (e.g., Clustering)
- Different Prioritization Criteria (e.g., Professional Judgement)
- Different Evaluation Methods (e.g., Manual Realistic Error Seedings)
- Different Data Sets




QUESTIONS & SUGGESTIONS