

EBUS3030 Assignment 2

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October 25, 2018

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1 Assignment Overview & Requirements

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Business Intelligence - EBUS3030 Assignment 2

Assignment Outcomes

This assignment requires multiple outputs to be created to exhibit your understanding of business intelligence/data analysis through an example ‘real world’ question that is comparable to what you may be asked of you as you become an IT professional.

Key outcomes to be delivered are: Data Modelling/ETL to get the data in a usable format, Output of your analysis, Report summarising your findings and a presentation to the class of your work. The presentation is expected to concentrate more on your findings/recommendations as if it were a situation where you are presenting the response to the CEO.

Assignment Question

The CEO of ‘BIA Inc’ had been speaking to the Sales Executive and had heard about some recent work you had completed and thought you might be able to assist them with a problem they have.

“I’ve heard that you helped the Sales Exec recently with understanding more about our Newcastle site. I would now like your help to get a handle on the whole business. As you are aware, the Newcastle office is just 1 of 10 sites we have across the country. Unfortunately, sales in some items have dropped across the country in recent years and we are currently running at a loss.

We need to consider consolidating our company offices. We need to reduce costs for the longevity of the company as a whole. I need you to get some numbers together around the performance of our 10 offices, so that I can factor this information into any decision regarding which office (or offices) we might consider closing.

I would like a summary of recent numbers and some trend analysis as well please. It would be great if you could also project sales for the next 12 months for each office as well. It would be helpful if you could indicate the 3 most popular and 3 least popular items in each of our stores, as well as the worst performing items for the company as a whole.

As you can imagine, this is a very sensitive topic so, as part of your response I want you to provide the justification as to which office we may close. Our decision will upset some people and I want to make sure we have all the background information on hand. If you can provide a Ranking of offices based on your analysis that would be wonderful.

.... I believe you started to bring together a data store of this information from the Newcastle Office, can you expand that and load all of the sales information for all offices and complete your analysis.
”

Assignment Deliverables

Using the data file provided in Excel and notes about the data (*Assignment 2 – data.xlsx*), you are required to complete the following elements as part of the assignment.

- Data Model/Data Load Process
 - Provide an overview of the data model & ETL process completed to get the data ready for analysis
 - Ensure you record any assumptions you have made as part of this component and your reasoning behind the assumption.
- Analysis including any predictive work undertaken
 - Provide the SQL and raw output of your base analysis
 - Provide workings of the predictive work you completed for the trending & prediction on future sales.
 - Ensure you record any assumptions you have made as part of this component and your reasoning behind the assumption (this includes answers to any relevant questions put to management (your lecturer) during workshops.

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- Executive Summary & Presentation in response to business question.
 - Provide an Executive report and Dashboard
 - Your Executive report should include a short Executive brief/summary that presents a clear concise response back to the CEO question about possible downsizing of operations including evidence/justification.
 - A dashboard should allow quick comparisons between the sites to be undertaken as well as contain at least one element of 'predictive' analysis
 - Present the material as if it is to be consumed in a formal boardroom meeting
 - All members of the team need to participate in a (15 – 20 minute) presentation to be given as part of the lab in Week 11.
 - Please be aware that any of the company Executive may ask questions as you present your findings.

NB: As part of your response, you should also specifically include any assumptions/external information you have made/used throughout the process as well as any quality processes/checking you have completed or limitations you discovered.

Breakup of assignment Marks (total course mark for assignment = Assignment Part B submission (28% + Presentation Two (7%) = 35%).

Assignment Component	Percentage Allocation
Data Model/ETL	10%
Core Analysis	50%
Executive Summary/Evidence	25%
Dashboard	15%
	100%

Key Documents Required & Format

You are required to upload all files in a single zip file (including any presentation items for the team delivery within the lab) via blackboard to the Assignment Two drop folder by 12 noon, Thursday 25th October. You will also be required to submit a paper copy of your report at the beginning of the presentation workshop (make sure this is printed well before the workshop and has a group Assessment Cover sheet signed by ALL team members).

NB: Only 1 load per team only but it should contain all of the deliverable items.

Your data model should include a printout of an ER diagram using the notation described in lectures. It should also include a printout of your SQL schema showing Primary and foreign keys, as well as all attributes.

Your presentation is worth 7% of the course mark. It should simulate presenting the report to management. You should time your presentation to be between 12-15 minutes with 5-10 minutes for questions. Your presentation should include a demonstration of your dashboard, results and recommendations from your analysis. Your presentation marks will contain components for organisation, comprehension of presented results, and timing.

2 Executive Summary

This report was created to address the request made by the CEO of BIA Incorporated in particular the concerns that the business is operating at a loss and certain stores, employees and inventory items were not performing to the expected standard. Based on the data set provided by the firm, we performed extracted, transformed and loaded the set into a relational database created specifically for this project.

Analysis within this report includes data from across all 10 offices of BIA Incorporated.

We believe based upon the metrics we used that the Wagga Wagga office is the best performing with \$1,807,157.30 in revenue and that the Wollongong Office is the worst performing with \$891,871.68 in revenue.

Wollongong was selected based on the included analysis in this report to be the closed branch. If Wollongong is exempt, then we would recommend the Dubbo Office be closed. The worst performing item across the whole store is the 'Drill Bit (6mm)' with a sales count of 19,481. For further details please view the [conclusion and recommendations section](#)..

2.1 Datamart Business Rules

The following business rules were provided to be used in the context of this assignment:

- At BIA all customers interact are in an online environment. We only support electronic orders.
- Returning customers can provide POI information via the web interface and look up their record and that will flow with the sale.
- The sales associate can complete the order form/sale for the client.
- Each sale will have a receipt number/id.
- A receipt can have many line items
- Each line item can only be for a single item, but the customer can purchase multiples of the same item.
- After consultation with your team, we have made the following change to discount applied to sales: Where a customer has multiple line items, any sale with 5 or more row items (containing at least 5 different items) is provided a 5% discount.
- The system automatically handles the total for the sale by looking up the item, then multiplying the costs per item by number purchased, and then should store this final field total as a record in the system (but should also be able to see clearly sales that were provided a discount.
- Store Item prices can change at any point, however the price the customer pays is the amount listed for the store item that is sold on the sale date. We need to keep a record of all store item prices historically so that we can determine what the store item price was at any particular past date.
- Only one BIA sales assistant can be attributed to any receipt.
- Customers may visit multiple stores for purchases (ie they are not locked to a particular store). As a result, all customer records are replicated across all stores, so they do not need to be re-recorded at a store by store level.

With these considerations in mind, the following report was created to outline the discovery, creation and polish to satisfy the assignment requirements.

3 Data Model

The following section outlines the models used in the design and creation of the database. It includes the EER Model with relations, attributes and relationships as well as the database schema from Microsoft SQL Server Management Studio.

3.1 Database Schema

The below data model is only a suggestion and is still subject to change into the future. A full create script can be found in the [appendix](#)

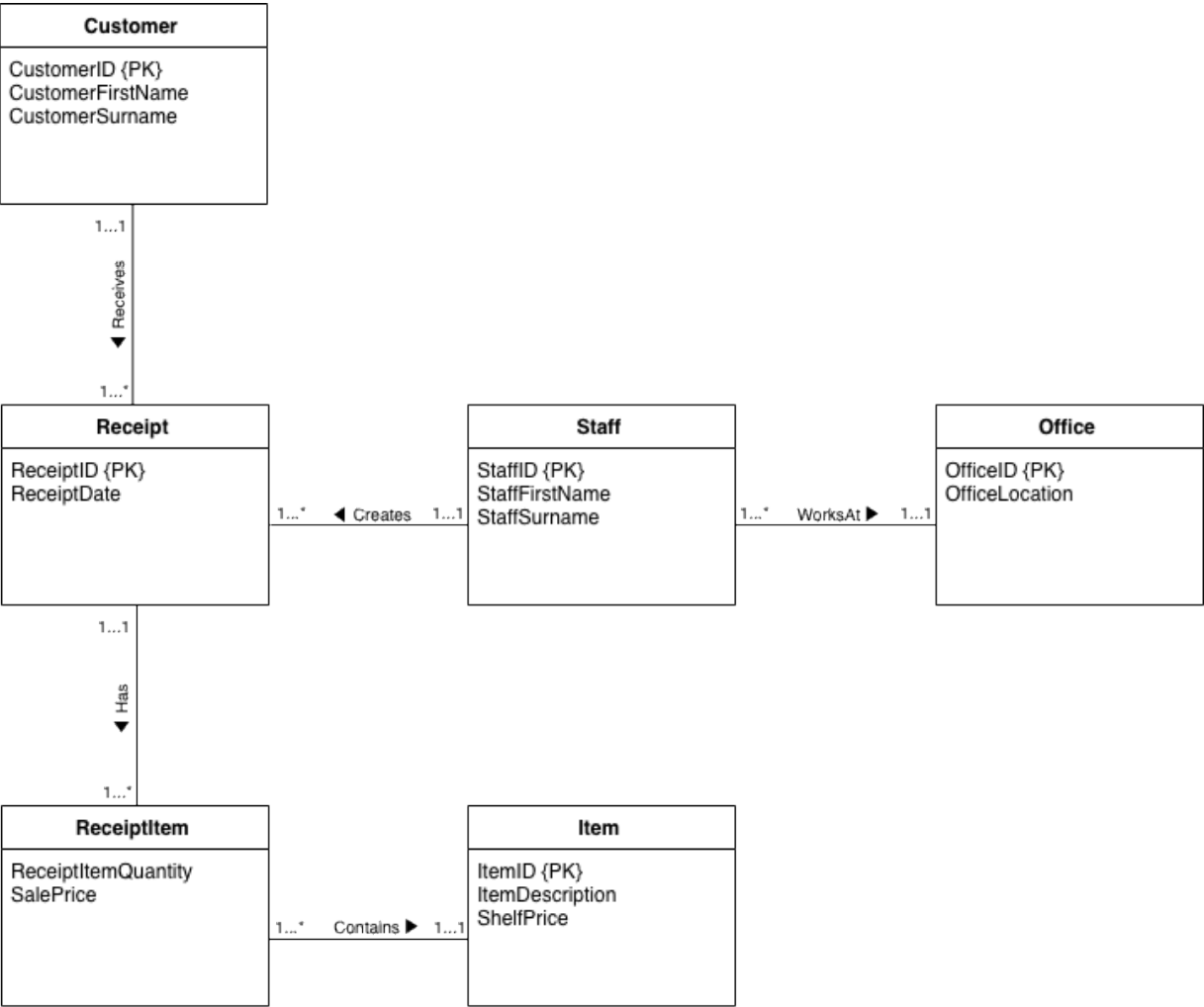


It must be noted that the structure of this data model is less than efficient, and it would be expected in a datamart situation that only at lower levels of data would this schema remain responsive in the manner it is now, as the outline suggests the datamart is not necessarily the most suitable design for future use, however suits very well currently.

It would be expected that only at extremely large data sets would this model prove a bad design. In such cases a model more representative of the snowflake or star schema would be heavily advised.

3.2 EER Diagram

An EER diagram of the suggested data model is provided below.



4 Data Load Process (ETL/ELT)

Initial import of the data supplied in the xlsx file generated a very basic table that allowed us to analyze the data for potential outliers, confirm the business requirements of the data and then create tables from which the data model was derived.

The Imported table structure was as follows:

Assignment2Data			
	Column Name	Data Type	Allow Nulls
	Sale_Date	datetime2(7)	<input type="checkbox"/>
	Reciept_Id	int	<input type="checkbox"/>
	Customer_ID	nvarchar(50)	<input type="checkbox"/>
	Customer_First_Name	nvarchar(50)	<input type="checkbox"/>
	Customer_Surname	nvarchar(50)	<input type="checkbox"/>
	Staff_ID	nvarchar(50)	<input type="checkbox"/>
	Staff_First_Name	nvarchar(50)	<input type="checkbox"/>
	Staff_Surname	nvarchar(50)	<input type="checkbox"/>
	Staff_office	int	<input type="checkbox"/>
	Office_Location	nvarchar(50)	<input type="checkbox"/>
	Reciept_Transaction_Row_ID	int	<input type="checkbox"/>
	Item_ID	int	<input type="checkbox"/>
	Item_Description	nvarchar(50)	<input type="checkbox"/>
	Item_Quantity	int	<input type="checkbox"/>
	Item_Price	float	<input type="checkbox"/>
	Row_Total	float	<input type="checkbox"/>
			<input type="checkbox"/>

A decision to leave this initial import table as default was made to allow easy reference to the initially supplied excel data file.

4.1 Quality Assurance Processes

After performing a basic query to determine if, like our previous project, multiple items of the same ID on a single receipt existed it was apparent that the same issue existed in this data set as did in the previous.

To mitigate this, the team developed a simple update to the ReceiptItem was performed, to ensure that a discount would not be applied to a receipt with less than five items, when potentially the receipt did not actually have more than four distinct items.

The following query was used to determine this information:

```
1  -- Verify that no receipt has duplicate ItemIds and all are unique per order
2  SELECT *
3  FROM
4  (
5      SELECT [ReceiptItem].[ReceiptId],
6      COUNT([ReceiptItem].[ReceiptId]) AS 'ItemCount',
7      COUNT(DISTINCT [ReceiptItem].[ItemId]) AS 'ItemIdCount',
8      FROM [ReceiptItem]
9      GROUP BY [ReceiptItem].[ReceiptId]) AS SubQuery
10 WHERE [SubQuery].[ItemIdCount] != [SubQuery].[ItemCount]
```

Returning no entries once the data was cleaned with a [C# Script](#) internally developed. This took into account not only checking for data integrity but generated new sql to facilitate [item consolidation](#). These scripts have been listed in the appendices of this report.

4.2 Assumptions and Reasoning

The following section outlines our assumptions and the reasoning behind certain decisions made by the team at any stage of the project. The team will always try to apply business rules supplied by the firm to any of the decisions made however this is not always possible. In this case, the reasoning has been listed in the section that follows.

4.2.1 Item

There were no major assumptions made for the items. We followed the feedback received from the previous project and used the associative entity of ReceiptItem to satisfy requirements of sale price and quantity.

4.2.2 ReceiptItem

As suggested above, the ReceiptItem table was created to satisfy feedback received on our previous project , allows for quantity and price association.

4.2.3 Receipt

The receipt had no changes in comparison to the previous analysis, the changes occurred in related entities and did not affect the receipt table.

4.2.4 Staff

Staff were left untouched, the relation to location however did play a large role in this analysis, and a major assumption of a staff member only being at one location at a time or being directly related only to the one location was made.

This assumption normally would not be made, but assurances of data cleanliness were made, and the C# script did not find any discrepancies between our assumption and the supplied information.

4.2.5 Customer

~~We made assumptions that customers are likely to shop at only the one store. Given the geographic distances between stores generally being larger than we deemed most people would be likely to travel.~~ This assumption was quickly invalidated as most customers seem to have shopped at most if not all stores.

4.2.6 Office

Our analysis assumed future office potential growth to be related to the locality of the store. Such an assumption may suggest that we weighed in favour of stores in high population areas if the analysis was borderline for example: Newcastle and Broken Hill; Newcastle would be favoured as the growth potential was assumed to be greater and more predictable into the future.

5 Base Analysis

5.1 Notes on Analysis

Analysis was performed using Microsoft SQL Management Studio, with a flat file of the original data being imported into the table as defined [here](#), as with the previous assignment utilisation of decimal(18.7) was our choice over using the money type, again citing the imprecision of money in MSSQL/TSQL [1].

Source files to imitate the analysis below is either included inline under their respective headers or can be found in the source files within the final submission. The following section also contains tables with a selection of results from the corresponding SQL script.

5.2 Raw Results

5.2.1 Total Revenue Per Store

The total revenue per store after discounts were applied was determined by the following query. Below the query, the selected results were included.

```
1  -- Item Count, total revenue, sold By Office Location with discount
2  SELECT (CAST(
3      CASE
4          WHEN COUNT(ri.[ReceiptItemQuantity]) >= 5
5              THEN SUM(ri.[SalePrice] * ri.[ReceiptItemQuantity]) * 0.95
6          ELSE SUM(ri.[SalePrice] * ri.[ReceiptItemQuantity])
7          END AS decimal(19,5)) AS 'Revenue',
8  o.OfficeId, o.OfficeLocation
9  FROM Receipt r
10     INNER JOIN ReceiptItem ri
11         ON r.ReceiptId = ri.ReceiptId
12     INNER JOIN Staff s
13         ON s.StaffId = r.ReceiptStaffId
14     INNER JOIN Office o
15         ON s.StaffOfficeId = o.OfficeId
16  GROUP BY o.OfficeId
17           , o.OfficeLocation
18  ORDER BY Revenue DESC;
```

Revenue	OfficeId	OfficeLocation
\$1807157.30	9	Wagga Wagga
\$1243761.42	2	Maitland
\$1206763.76	10	Broken Hill
\$1113333.40	4	Sydney
\$1109330.77	1	Newcastle
\$1092924.88	5	Port Macquarie
\$1006184.56	3	Cessnock
\$1001501.30	6	Grafton
\$934267.47	7	Dubbo
\$891871.68	8	Wollongong

Consideration of the above table was taken when looking at which store we suggested to close, but was not the only deciding factor in our conclusion.

5.2.2 Total Number of Sales per Staff Member

The total number of sales per staff member were considered with the following query. Below the query, the selected results were included.

```
1 SELECT COUNT(*) AS 'Sales Count'
2           , s.StaffId
3           , s.StaffFirstName
4           , s.StaffSurname
5           , o.OfficeId
6           , o.OfficeLocation
7 FROM Receipt r
8      INNER JOIN ReceiptItem ri
9                  ON r.ReceiptId = ri.ReceiptId
10     INNER JOIN Item i
11                  ON i.ItemId = ri.ItemId
12     INNER JOIN Staff s
13                  ON s.StaffId = r.ReceiptStaffId
14     INNER JOIN Office o
15                  ON o.OfficeId = s.StaffOfficeId
16 GROUP BY s.StaffId
17           , s.StaffFirstName
18           , s.StaffSurname
19           , o.OfficeId
20           , o.OfficeLocation
21 ORDER BY 'Sales Count' DESC;
```

Sales Count	StaffId	StaffFirstName	StaffSurname	OfficeId	OfficeLocation
645	S190	Samuel	Anderson	4	Sydney
628	S196	Devin	Brown	6	Grafton
628	S122	Austin	Morris	6	Grafton
608	S101	Jenna	Cox	5	Port Macquarie
607	S45	Emma	Gutierrez	3	Cessnock

This suggests to us that individual stores had, either more sales or higher performing employees, which we wanted to confirm in analysis later, of which can be found [here](#).

5.2.3 Total Items Sold

The total items attributed to each staff member were considered also, determined by the query. Below the query, the selected results were included.

```
1 SELECT SUM(ri.ReceiptItemQuantity) AS 'Item Count'
2       , s.StaffId
3       , s.StaffFirstName
4       , s.StaffSurname
5       , o.OfficeId
6       , o.OfficeLocation
7 FROM Receipt r
8      INNER JOIN ReceiptItem ri
9                      ON r.ReceiptId = ri.ReceiptId
10     INNER JOIN Staff s
11                      ON s.StaffId = r.ReceiptStaffId
12     INNER JOIN Office o
13                      ON o.OfficeId = s.StaffOfficeId
14 GROUP BY s.StaffId
15         , s.StaffFirstName
16         , s.StaffSurname
17         , o.OfficeId
18         , o.OfficeLocation
19 ORDER BY 'Item Count' DESC;
```

Item Count	StaffId	StaffFirstName	StaffSurname	OfficeId	OfficeLocation
4005	S190	Samuel	Anderson	4	Sydney
3796	S122	Austin	Morris	6	Grafton
3730	S101	Jenna	Cox	5	Port Macquarie
3716	S45	Emma	Gutierrez	3	Cessnock
3684	S108	Isaiah	Powell	9	Wagga Wagga

Consideration of the total items sold was important in determining our conclusion also, we recognise that while the top and bottom 3 performing items was a requirement, the spread of item sales was marginal in the end result as suggested [here](#), with an overall spread of the items sold (quantity) of only roughly 1500 between best and worst performers.

5.2.4 Discounted Sales Ratio

Consideration of the number of sales made by each staff member was also made, the following query yielding the results we required. Below the query, the selected results were included.

```
1 SELECT s.StaffId
2         , s.StaffFirstName
3         , s.StaffSurname
4         , o.OfficeId
5         , o.OfficeLocation
6         , SUM(SubQuery.[Discounted Sales]) AS 'Discounted Sales'
7         , SUM(SubQuery.[Standard Sales]) AS 'Standard Sales'
8 FROM (
9     SELECT CAST(
10        CASE
11            WHEN COUNT(ri.[ReceiptItemQuantity]) >= 5
12                THEN 1
13            ELSE 0
14        END AS INT) AS 'Discounted Sales',
15        CAST(
16            CASE
17                WHEN COUNT(ri.[ReceiptItemQuantity]) >= 5
18                    THEN 0
19                ELSE 1
20            END AS INT) AS 'Standard Sales',
21        r.ReceiptId
22    FROM Receipt r
23         INNER JOIN ReceiptItem ri
24             ON r.ReceiptId = ri.ReceiptId
25         INNER JOIN Item i
26             ON i.ItemId = ri.ItemId
27    GROUP BY r.ReceiptId
28 ) AS SubQuery
29     INNER JOIN Receipt r
30         ON SubQuery.ReceiptId = r.ReceiptId
31     INNER JOIN ReceiptItem ri
32         ON r.ReceiptId = ri.ReceiptId
33     INNER JOIN Staff s
34         ON s.StaffId = r.ReceiptStaffId
35     INNER JOIN Office o
36         ON o.OfficeId = s.StaffOfficeId
37 GROUP BY s.StaffId
38         , s.StaffFirstName
39         , s.StaffSurname
40         , o.OfficeId
41         , o.OfficeLocation
42 ORDER BY [Discounted Sales];
```

StaffId	StaffFirstName	StaffSurname	OfficeId	OfficeLocation	Discounted Sales	Standard Sales
S51	Haley	Taylor	7	Dubbo	263	91
S161	Jason	Wood	7	Dubbo	273	117
S17	Daniel	Baker	1	Newcastle	278	112
S135	Lexi	James	4	Sydney	280	100
S73	John	White	2	Maitland	286	121

5.2.5 Total Sales Value per Staff Member

```
1 SELECT CAST(  
2     CASE  
3     WHEN COUNT(ri.[ReceiptItemQuantity]) >= 5  
4         THEN SUM(ri.[SalePrice] * ri.[ReceiptItemQuantity]) * 0.95  
5     ELSE SUM(ri.[SalePrice] * ri.[ReceiptItemQuantity])  
6     END AS decimal(19,5)) AS 'Sales Totals'  
7     , s.StaffId  
8     , s.StaffFirstName  
9     , s.StaffSurname  
10    , o.OfficeId  
11    , o.OfficeLocation  
12 FROM Receipt r  
13     INNER JOIN ReceiptItem ri  
14                 ON r.ReceiptId = ri.ReceiptId  
15     INNER JOIN Item i  
16                 ON i.ItemId = ri.ItemId  
17     INNER JOIN Staff s  
18                 ON s.StaffId = r.ReceiptStaffId  
19     INNER JOIN Customer c  
20                 ON c.CustomerId = r.ReceiptCustomerId  
21     INNER JOIN Office o  
22                 ON o.OfficeId = s.StaffOfficeId  
23 GROUP BY s.StaffId  
24           , s.StaffFirstName  
25           , s.StaffSurname  
26           , o.OfficeId  
27           , o.OfficeLocation  
28 ORDER BY 'Sales Totals' DESC;
```

Sales Totals	StaffId	StaffFirstName	StaffSurname	OfficeId	OfficeLocation
\$77152.49	S187	Savannah	Jones	8	Wollongong
\$75113.60	S45	Emma	Gutierrez	3	Cessnock
\$72475.45	S178	Kaitlyn	Nguyen	2	Maitland
\$71814.20	S122	Austin	Morris	6	Grafton
\$71497.09	S71	Danielle	Myers	6	Grafton

As with the first assignment, we did consider the total revenue each staff member generated to formulate our conclusion, but this was not as heavy of a weighing as other methods of analysis we performed.

One particularly interesting outlier in the data being Savannah Jones, whom topped the sales revenue chart, but belongs to the store we intend on closing. Further analysis on staff performance in order to offer transfers to valuable staff would be highly recommended.

5.2.6 Average Value Per Sale

```
1 SELECT (CAST(  
2     CASE  
3     WHEN COUNT(ri.[ReceiptItemQuantity]) >= 5  
4         THEN SUM(ri.[SalePrice] * ri.[ReceiptItemQuantity]) * 0.95  
5     ELSE SUM(ri.[SalePrice] * ri.[ReceiptItemQuantity])  
6     END AS decimal(19,5)) / COUNT(r.ReceiptId)) AS 'Sales Average'  
7     , s.StaffId  
8     , s.StaffFirstName  
9     , s.StaffSurname  
10    , o.OfficeId  
11    , o.OfficeLocation  
12 FROM Receipt r  
13 INNER JOIN ReceiptItem ri  
14         ON r.ReceiptId = ri.ReceiptId  
15 INNER JOIN Item i  
16         ON i.ItemId = ri.ItemId  
17 INNER JOIN Staff s  
18         ON s.StaffId = r.ReceiptStaffId  
19 INNER JOIN Office o  
20         ON o.OfficeId = s.StaffOfficeId  
21 GROUP BY s.StaffId  
22         , s.StaffFirstName  
23         , s.StaffSurname  
24         , o.OfficeId  
25         , o.OfficeLocation  
26 ORDER BY 'Sales Average' DESC;
```

Sales Average	StaffId	StaffFirstName	StaffSurname	OfficeId	OfficeLocation
\$138.40	S109	Nicole	Hernandez	10	Broken Hill
\$134.88	S187	Savannah	Jones	8	Wollongong
\$134.71	S52	Isabella	Rivera	5	Port Macquarie
\$134.53	S165	Marcus	Ross	2	Maitland
\$134.12	S199	Maria	Smith	5	Port Macquarie

5.3 Total Items and Revenue per Store

```
1  -- Item Count, total revenue, sold By Office Location with discount
2  SELECT (CAST(
3      CASE
4          WHEN COUNT(ri.[ReceiptItemQuantity]) >= 5
5              THEN SUM(ri.[SalePrice] * ri.[ReceiptItemQuantity]) * 0.95
6          ELSE SUM(ri.[SalePrice] * ri.[ReceiptItemQuantity])
7          END AS decimal(19,5))) AS 'Revenue',
8  SUM(ri.ReceiptItemQuantity) AS ItemCount,
9  o.OfficeId, o.OfficeLocation
10 FROM Receipt r
11     INNER JOIN ReceiptItem ri
12         ON r.ReceiptId = ri.ReceiptId
13     INNER JOIN Staff s
14         ON s.StaffId = r.ReceiptStaffId
15     INNER JOIN Office o
16         ON s.StaffOfficeId = o.OfficeId
17 GROUP BY o.OfficeId
18         , o.OfficeLocation
19 ORDER BY ItemCount DESC;
```

Revenue	ItemCount	OfficeId	OfficeLocation
\$1807157.30	97020	9	Wagga Wagga
\$1243761.42	65637	2	Maitland
\$1206763.76	65568	10	Broken Hill
\$1109330.77	59946	1	Newcastle
\$1113333.40	59229	4	Sydney
\$1092924.88	56429	5	Port Macquarie
\$1006184.56	52315	3	Cessnock
\$1001501.30	51533	6	Grafton
\$934267.47	49456	7	Dubbo
\$891871.68	46433	8	Wollongong

5.4 Unique Customers Per Store

Total number of customers per store were determine via the below query:

```
1 -- Unique Customer Count Per Store
2 SELECT COUNT(*) AS 'Customer Count', o.[OfficeLocation]
3 FROM Customer c
4 INNER JOIN Receipt r ON r.ReceiptCustomerId = c.CustomerId
5 INNER JOIN Staff s ON s.StaffId = r.ReceiptStaffId
6 INNER JOIN Office o ON o.OfficeId = s.StaffOfficeId
7 GROUP BY o.[OfficeLocation]
8 ORDER BY 'Customer Count' DESC;
```

Customer Count	OfficeLocation
600	Wagga Wagga
584	Maitland
581	Port Macquarie
581	Broken Hill
577	Sydney
574	Newcastle
571	Cessnock
564	Dubbo
559	Grafton
556	Wollongong

This suggests that customers will shop at a number of stores, not just the single store in their locality. Having reflected upon the findings and knowing that the unique pool of customers in this dataset of 600 also suggests that a customer can order from anywhere and have the item delivered or transfered to a local store potentially. Given this, we assume that closing a store will not greatly impact customer retention if an online outlet can be reached.

5.5 Item Popularity

The script below addresses the concern of the CEO which required the team to analyse the popularity of items across all stores, and each store individually. The SQL query joins multiple tables in our database and uses an integer, which is a unique identifier for each office location. The results of this script can be found listed below in two separate outputs. The first outlines the highest performing items per store whereas the second highlights the worst performing items for each store.

```
1 SELECT SUM(ri.ReceiptItemQuantity) AS ItemCount
2   , i.ItemId
3   , i.ItemDescription
4   , o.OfficeId
5   , o.OfficeLocation
6 FROM Receipt r
7     INNER JOIN ReceiptItem ri
8         ON ri.ReceiptId = r.ReceiptId
9     INNER JOIN Item i
10        on i.ItemId = ri.ItemId
11     INNER JOIN Staff s
12        on s.StaffId = r.ReceiptStaffId
13     INNER JOIN Office o
14        on o.OfficeId = s.StaffOfficeId
15 WHERE o.OfficeId = 1
16 GROUP BY i.ItemId
17         , i.ItemDescription
18         , o.OfficeId
19         , o.OfficeLocation
20 ORDER BY ItemCount ASC;
```

Office ID	Item ID	Highest Quality 1	Item ID	Highest Quality 2	Item ID	Highest Quality 3
1	24	2144	13	2153	26	2176
2	7	2328	28	2371	5	2374
3	10	1885	18	1900	22	2144
4	16	2151	20	2157	4	2185
5	20	2038	27	2042	10	2051
6	25	1846	16	1856	2	1881
7	20	1807	30	1808	24	1864
8	5	1674	8	1696	16	1765
9	25	3405	21	3478	14	3566
10	14	2376	22	2384	8	2436

Office ID	Item ID	Lowest Quality 1	Item ID	Lowest Quality 2	Item ID	Lowest Quality 3
1	11	1756	2	1765	17	1866
2	27	1947	9	1966	2	2027
3	5	1465	8	1500	27	1561
4	23	1767	13	1810	14	1829
5	1	1563	8	1663	6	1680
6	29	1537	20	1562	17	1573
7	25	1397	4	1471	2	1494
8	14	1383	17	1422	24	1424
9	16	2945	23	3001	28	3010
10	5	1939	11	1962	13	1980

5.6 Worst Performing Item

Listed below is the SQL scripts associated with finding the worst performing item, overall, across the entire company including all locations. The results for this SQL script can be found below. These results list the count of items sold, the items unique identifier and a description of the item.

```
1  --worst performing items for the company as whole
2  SELECT SUM(ri.ReceiptItemQuantity) AS ItemCount
3         , i.ItemId
4         , i.ItemDescription
5  FROM Receipt r
6       INNER JOIN ReceiptItem ri
7              ON ri.ReceiptId = r.ReceiptId
8       INNER JOIN Item i
9              ON i.ItemId = ri.ItemId
10 GROUP BY i.ItemId , i.ItemDescription
11 ORDER BY ItemCount ASC;
```

ItemCount	ItemId	ItemDescription
19481	23	Drill Bit 6mm
19613	13	Ruler
19741	2	Screwdriver Set
19744	9	Box of Screws
19746	17	Punch

6 Conclusion and Recommendations

This report was created for, and to address the concerns of, the CEO of BIA Incorporated. The purpose of the report is to provide insight into the methodology employed by our team in our analysis and logical reasoning for making the recommendations listed through the document and in the presentation. Citing declining sales of certain items in recent years and the fact that the company is currently operating at a financial loss, our team understood the need to reduce costs to ensure the longevity of the company as a whole. To achieve this, we used tools and frameworks including SQL Server Management Studio (SSMS), PowerBI, SQL and C# scripts. To ensure this longevity is sustained, the team first considered the sales data set provided by the company and the slightly modified business rules, when compared to our last joint project with the company. We created scripts and programmed solutions to deal with instances of broken data and to ensure that as the data is loaded into our database model, it adheres to the rules provided by the business. We considered specifically the changed discount rate which was different to the rate in use by the company at the time of our last project.

After the data had been correctly loaded, we could begin the analysis. The findings of this process suggested that, based on revenue, the highest performing store was Wagga Wagga with \$1,807,157.30 in revenue, whereas the store which performed the worst was Wollongong with \$891,871.68 in revenue, \$42,395.79 behind the second worst performing store, Dubbo. This analysis was performed after discounts were applied to better reflect the actual monetary value gained by the company. Overall, we found that customers are not loyal to any particular store. With the store with the highest amount of unique customers, Wagga Wagga with 600 only 44 ahead of Wollongong, the store with the lowest amount of unique customers with 556. For each store, we considered the best and worst performing items overall. The findings of this can be outlined in the report. We found that there is no significant discrepancy of any specific item across the company as a whole. The 'Drill Bit (6mm)' had an item sales count of 19,481, the second worst performing item was the 'Ruler' with 19,613 sales.

Next we considered total number of sales and total items sold by individual employees to find whether individual stores had either more sales or higher performing employees. We found that the highest performing employee was Mr. Samuel Anderson, who is located at the Sydney store. Mr. Anderson achieved a sales count of 645 overall sales and 4005 items sold. The second placed employee was Mr. Devin Brown who achieve 628 overall sales with 3796 items sold. Our next consideration was the discounted sales rate per employee. We found that the employees with the most discounted sales were situated at the Dubbo store, one of the lowest performing locations overall. Ms. Haley Taylor had 263 discounted sales compared to 91 standard sales meaning approximately 74% of Ms. Taylor's overall sales were discounted. The employee with the second highest amount of discounted sales was Mr. Jason Wood, also from the Dubbo store. Mr. Wood had 273 discounted sales and 117 standard sales meaning approximately 70% of Mr. Wood's sales were discounted. The next metric was the total sales value per staff member. Collectively, we decided that it was important to present the findings of which staff members generate value for the company. We found that Ms. Savannah Jones of the Wollongong store topped the list with \$77,152.49 sales value in total. Although the Wollongong store is the worst performing store overall, Ms. Jones outperforms all other staff members in total sale value, even when considering the discounted rate which was applied in this analysis. In addition to this, Ms. Jones placed second in average value per sales, approximately \$4.00 behind first place, Ms. Nicole Hernandez from the Broken Hill store with an average sale of \$138.40.

After carefully considering the aforementioned key metrics and reviewing the results, we can conclude that out of the 10 offices that are under observation the results point to us closing down the Wollongong branch. This result was not taken lightly as a lot of collaboration with throughout the analytics team reviewing the data. The Wollongong office was the worst performer \$891,871.68 in revenue, \$42,395.79 behind the second worst performing store. The 2018 predictions were also taken in to consideration when trying to come to a conclusion and it could be seen that even when Wollongong was predicted to make an improvement in 2018 over 2017 it was still lower than the predicted of the second worst store Dubbo. Upon this decision we believe that if the Wollongong office was to be closed then we would recommend that BIA Incorporated would offer Ms. Savannah Jones a position at one of the other offices close by (e.g. Sydney). This is because we believe that Ms. Savannah Jones is a valuable staff member here at BIA Incorporated and in 2017 was the staff member who made the most revenue for the company.

6.1 Limitations of the report

We cannot provide any information on profit as there is no expenditure data given. It proved difficult to generate an extropolation of the dataset given only a year of sales data. A year of sales data may be a poor represenation of the potential of the Wollongong store and We do not know if Wollongong's poor performance is due to it only being a new store that opened at the beginning of the 2017 or some other factor. A lack of staff spending data made it impossible to determine if staff members were generating revenue or the net profit for the business per employee. Furthermore items were hard to analyse given the lack of expenditure data around the items.

References

- [1] Reasons against TSQL Money type: Stackoverflow User; *SQLMenace* <https://stackoverflow.com/questions/582797/should-you-choose-the-money-or-decimalx-y-datatypes-in-sql-server>

7 Appendix

7.1 C# Code Excerpt: Cleaning

```
1 public Tuple<Dictionary<int, Receipt>, Dictionary<int, Receipt>, int> GenerateReceipts(DataSet dataSet)
2 {
3     var receipts = new Dictionary<int, Receipt>();
4     var invalidReceipts = new Dictionary<int, Receipt>();
5     var counter = 0;
6
7     // Iterate over each sheet in the dataset, in our case it's only one anyway.
8     foreach (DataTable table in dataSet.Tables)
9         // Iterate over each row in the dataset, it seems this iterates until it finds row with no values in any
            column.
10        foreach (DataRow row in table.Rows)
11        {
12            // Ignore the header of the table
13            if (counter > 0)
14            {
15                // Generation of receipt from dataset, ignoring transaction row id as it is not
16                // relevant and we are consolidating the duplicate items into total quantities anyway.
17                var receipt = new Receipt
18                {
19                    Id = Convert.ToInt32(row[1]),
20                    Customer = new Customer
21                    {
22                        FirstName = row[3].ToString(),
23                        Id = row[2].ToString(),
24                        Surname = row[4].ToString()
25                    },
26                    Staff = new Staff
27                    {
28                        OfficeId = Convert.ToInt32(row[8]),
29                        Id = row[5].ToString(),
30                        FirstName = row[6].ToString(),
31                        Surname = row[7].ToString()
32                    },
33                    SaleDate = (DateTime)row[0],
34                    Items = new Dictionary<int, Item>
35                    {
36                        {
37                            Convert.ToInt32(row[11]), new Item
38                            {
39                                Id = Convert.ToInt32(row[11]),
40                                Description = row[12].ToString(),
41                                Price = (double) row[14],
42                                Quantity = Convert.ToInt32(row[13])
43                            }
44                        }
45                    },
46                    Office = new Office
47                    {
48                        Id = Convert.ToInt32(row[8]),
49                        OfficeLocation = ParseEnum<Location>(row[9].ToString())
50                    }
51                };
52
53
54
55
56
```

```

57 // Check if receipts either is empty or doesn't have a receipt
58 // with the same receipt id already, if so add the receipt to
59 // receipts .
60 if (receipts.Count == 0 || !receipts.ContainsKey(receipt.Id))
61 {
62     AddToReceipts(receipts, receipt);
63     Console.WriteLine($"@Added new receipt: {receipt.Id}");
64 }
65 //
66 else if (receipts.ContainsKey(receipt.Id))
67 {
68     var existingReceipt = receipts[receipt.Id];
69
70     // Be warned; below is a fucking mess.
71
72     // Check all staff properties match the existing receipt properties.
73     if (existingReceipt.Staff.Id != receipt.Staff.Id
74         || existingReceipt.Staff.FirstName != receipt.Staff.FirstName
75         || existingReceipt.Staff.Surname != receipt.Staff.Surname)
76     {
77         AddToReceipts(invalidReceipts, receipt);
78         Console.WriteLine($"Staff Id mismatch on receipt: {existingReceipt.Id}, " +
79             $"Staff Ids: {existingReceipt.Staff.Id} and {receipt.Staff.Id}, " +
80             $"Staff Names: {existingReceipt.Staff.FirstName} and
81                 {receipt.Staff.FirstName}, " +
82             $"Staff Surnames: {existingReceipt.Staff.Surname} and
83                 {receipt.Staff.Surname}, ");
84         continue;
85     }
86
87     // Check all office properties match the existing receipt properties.
88     if (existingReceipt.Office.Id != receipt.Office.Id
89         || existingReceipt.Office.OfficeLocation != receipt.Office.OfficeLocation)
90     {
91         AddToReceipts(invalidReceipts, receipt);
92         Console.WriteLine($"Office Id mismatch on receipt: {existingReceipt.Id}, " +
93             $"Office Ids: {existingReceipt.Office.Id} and {receipt.Office.Id}, " +
94             $"Office Locations: {existingReceipt.Office.OfficeLocation} and
95                 {receipt.Office.OfficeLocation}");
96         continue;
97     }
98
99     // Check all date properties match the existing receipt properties.
100    if (existingReceipt.SaleDate != receipt.SaleDate)
101    {
102        AddToReceipts(invalidReceipts, receipt);
103        Console.WriteLine($"Sale date mismatch on receipt: {existingReceipt.Id}, " +
104            $"Dates: {existingReceipt.SaleDate} and {receipt.SaleDate}");
105        continue;
106    }
107
108
109
110
111
112
113
114

```

```

115 // Check all customer properties match the existing receipt properties.
116 if (existingReceipt.Customer.Id != receipt.Customer.Id
117     || existingReceipt.Customer.FirstName != receipt.Customer.FirstName
118     || existingReceipt.Customer.Surname != receipt.Customer.Surname)
119 {
120     AddToReceipts(invalidReceipts, receipt);
121     Console.WriteLine($"Customer mismatch on receipt: {existingReceipt.Id}, " +
122         $"Customers Ids: {existingReceipt.Customer.Id} and {receipt.Customer.Id}, "
123         +
124         $"Customers Names: {existingReceipt.Customer.FirstName} and
125         {receipt.Customer.FirstName}, " +
126         $"Customers Surnames: {existingReceipt.Customer.Surname} and
127         {receipt.Customer.Surname}, ");
128     continue;
129 }
130
131 // If not item mismatches exist, we need to determine if the item
132 // exists in both the compared receipts.
133 var key = receipt.Items.First().Key;
134 var value = receipt.Items.First().Value;
135
136 // Check if the item exists in the existing receipt already.
137 if (existingReceipt.Items.ContainsKey(receipt.Items.First().Key))
138 {
139     var quantity = receipt.Items.First().Value.Quantity;
140     Console.WriteLine($"Item exists in current receipt with Id: {key}, " +
141         $"updated item quantity from: {existingReceipt.Items[key].Quantity} " +
142         $"to new quantity: {existingReceipt.Items[key].Quantity + quantity}");
143
144     // Update quantity on item in existing receipt.
145     existingReceipt.Items[key].Quantity += quantity;
146     receipts[existingReceipt.Id] = existingReceipt;
147 }
148 else
149 {
150     // Update the receipt with the new item added.
151     existingReceipt.Items.Add(key, value);
152     Console.WriteLine($"@ Added item with Id: {value.Id} to existing receipt: {receipt.Id}");
153 }
154 }
155 counter++;
156 }
157
158 return new Tuple<Dictionary<int, Receipt>, Dictionary<int, Receipt>, int>(receipts, invalidReceipts,
    counter);
159 }

```

7.2 C# Code Excerpt: SQL Generation

```
1 public string GenerateSQL(Dictionary<int, Receipt> receipts)
2 {
3     var output = new StringBuilder();
4
5     foreach(var receipt in receipts)
6     {
7         var itemTotalPrices = new Dictionary<int, double>();
8
9         foreach (var item in receipt.Value.Items)
10        {
11            var totalItemPrice = item.Value.Price * item.Value.Quantity;
12            itemTotalPrices.Add(item.Key, totalItemPrice);
13        };
14
15        var total = itemTotalPrices.Sum(x => x.Value);
16        var discountTotal = (itemTotalPrices.Count >= 5) ? total * 0.95 : 0;
17
18        var sql = new StringBuilder(@"
19
20
21        INSERT INTO [Receipt]
22        VALUES('{'receipt.Value.SaleDate.ToString("G",CultureInfo.CreateSpecificCulture("en-us"))}',
23                {'receipt.Key},
24                {'receipt.Value.Customer.Id}',
25                {'receipt.Value.Staff.Id }',
26                {total },
27                {discountTotal});");
28
29        foreach (var item in itemTotalPrices)
30        {
31            sql.Append(@"
32
33        INSERT INTO [ReceiptItem]
34        VALUES( {'receipt.Key},
35                {item.Key},
36                {receipt.Value.Items.Select(x => x.Value).Where(y => y.Id == item.Key).FirstOrDefault().Quantity},
37                {receipt.Value.Items.Select(x => x.Value).Where(y => y.Id == item.Key).FirstOrDefault().Price});");
38        }
39
40        output.Append(sql);
41    };
42
43    return output.ToString();
44 }
```