ECON 607 Assignment 1

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1 Creating a database

Create a database consisting of the tables in Figure 1. You can import the tblCustomer.csv, tblMortgage.csv, and tblPropertyOwner.csv files available on LEARN. Add the entries in Figure 2 to the Customer table BEFORE you set the foreign key relationships. Back up the database and upload the .bak file to the LEARN Dropbox along with this completed Worksheet.

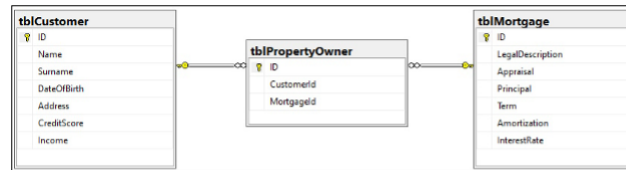Figure 1: Screen capture of the desired SSMS table diagram

Figure 2: List of new entries to be added to the database

1035	Emily Kim	05-Nov-50	6723 Merlot Avenue, Waterloo, ON N2G 2M6	805	41000
1036	Benjamin Button	31-Jan-03	9851 Shiraz Lane, Waterloo, ON N2G 6N1	815	108000
1037	Abigail Smith	07-Jul-89	5934 Cabernet Street, Waterloo, ON N2G 6D3	825	83000
1038	Victoria Smith	09-Nov-93	5934 Cabernet Street, Waterloo, ON N2G 6D3	855	95000
1039	Emma Black	06-Sep-78	2530 Champaign Park, Waterloo, ON N2G 8V4	870	160000
1040	Isabella Ojeida	24-Jul-01	9649 Paxton Street, London, ON N5V 7N9	520	125000

2 Calculate the CMHC Mortgage Insurance for all applicable mortgages

To calculate the CMHC Mortgage Insurance for all applicable mortgages, the first step I took was to create a new table containing the property owners; first and last name, credit score, income, property appraisal, down payment, amortization period and interest rate. I did this using SQL through the query provided in Figure 3.

Figure 3: SQL code used to create new table


```
USE assign1_db
SELECT
    dbo.customer_tbl.Name AS firstName,
    dbo.customer_tbl.Surname AS lastName,
    dbo.customer_tbl.CreditScore AS crScore,
    dbo.customer_tbl.Income AS Income,
    dbo.mortgage_tbl.Appraisal AS Appraisal,
    (dbo.mortgage_tbl.Appraisal - dbo.mortgage_tbl.Principal) AS downPayment,
    dbo.mortgage_tbl.Amortization as Amortization,
    dbo.mortgage_tbl.InterestRate as interestRate INTO mortgageCalc
FROM dbo.propertyOwner_tbl
    INNER JOIN dbo.mortgage_tbl ON dbo.propertyOwner_tbl.MortgageID = dbo.mortgage_tbl.ID
    INNER JOIN dbo.customer_tbl ON dbo.propertyOwner_tbl.CustomerID = dbo.customer_tbl.ID
```

Then with this information nicely formatted in a table, I was able to use the CMHC mortgage calculator at this link to calculate the property owners mortgage for all applicable mortgages. Figure 4 provides the results in the column named mortgageInsurance, note that I made the assumption that the mortgage will be paid monthly.

Figure 4: Output table of SQL code

	firstName	lastName	crScore	Income	Appraisal	downPayment	Amortization	interestRate	mortgageInsurance	ID
1	Maria	Pollo	600	145000	875000	200000	25	7.09999990463257	4769.14	1
2	David	Jones	530	8500	700000	35000	30	7.19999980926514	NULL	2
3	Jennifer	Jones	855	86000	700000	35000	30	7.19999980926514	NULL	3
4	John	Mendoza	700	76000	625000	145000	25	7	3362	4
5	Robert	Miller	715	65000	950000	210000	25	6.90000009536743	5137.47	5
6	Paul	Judd	780	57000	1200000	950000	25	5.80000019073486	NULL	6
7	Richard	O'Connor	800	92000	575000	275000	10	6.30000019073486	3363.68	7
8	James	Brown	810	48000	600000	220000	20	6.19999980926514	2748.9	8
9	Lisa	Brown	870	78000	600000	220000	20	6.19999980926514	2748.9	9
10	Brian	Donnally	815	71000	490000	162000	25	6.30000019073486	2157.41	10
11	Linda	Donnally	640	6300	490000	162000	25	6.30000019073486	2157.41	11
12	Karen	Miller	835	74000	690000	565000	5	6.09999990463257	2417.93	12
13	Susan	Franko	605	67000	850000	275000	15	6.59999990463257	5012.05	13
14	Pierre	Graham	705	67000	1600000	1255000	5	5.90000009536743	NULL	14
15	Claude	Graham	725	83000	1600000	1255000	5	5.90000009536743	NULL	15
16	Pierre	Graham	705	67000	450000	325000	10	6.09999990463257	1389.2	16
17	Yvonne	Hansen	520	46000	540000	495000	25	7.09999990463257	317.94	17
18	Vincent	Hensen	730	54000	540000	495000	25	7.09999990463257	317.94	18
19	Paul	Judd	780	57000	250000	170000	10	6.09999990463257	889.09	19
20	Paul	Judd	780	57000	300000	195000	10	6.09999990463257	1166.92	20
21	Tina	Koffman	490	114000	980000	150000	30	7.19999980926514	NULL	21
22	Abigail	Smith	825	83000	610000	115000	30	6.90000009536743	NULL	22
23	Isabella	Ojeida	520	125000	425000	22000	30	6.90000009536743	NULL	23
24	Tina	Koffman	490	114000	980000	895000	10	9.60000038146973	1095.86	24

While conducting the calculations I noticed there were some properties that could not be entered into the calculator (shown in Figure 4 with the highlighted NULL value). I referred to the general requirements to qualify for homeowner mortgage loan insurance through this link to understand why the property mortgages wouldn't be calculated.
Here I will explain the NULL values shown in Figure 4.

- Line 2: Amortization period is greater than 25 years.

- Line 3: Amortization period is greater than 25 years.

- Line 6: Appraisal (Property value) is greater than $1,000,000.

- Line 14: Appraisal (Property value) is greater than $1,000,000.

- Line 15: Appraisal (Property value) is greater than $1,000,000.

- Line 21: Amortization period is greater than 25 years.

- Line 22: Amortization period is greater than 25 years.

- Line 23: Amortization period is greater than 25 years.

3 Which Mortgages are most likely to default and why?

3.1 How to find mortgages that are most likely to default

To find which mortgages were most likely to default I will be using the Gross Debt Service ratio. The formula for the Gross Debt Service Ratio is given in Equation 1:

$$GDS_i = \frac{Principal_i + Interest_i + PropertyTaxes_i + Utilities_i}{GrossAnnualIncome_i} \quad (1)$$

Since we wont be calculating the exact property taxes and utilities of each individual property the revised equation is shown in Equation 2

$$GDS_i = \frac{Principal_i + Interest_i + PropertyTaxes + Utilities}{GrossAnnualIncome_i} \quad (2)$$

My first attempt was to create a table in SQL with all the information I would need then add an identifier and a Gross Debt Service Ratio Column, however the Property Taxes are specific to the area of the property and the value of the property. The Gross Debt Service Ratio Column formula, if generalized to a set property value and Canada wide average Property tax, would greatly misrepresent the likelihood of a default. Another note to make is that some properties will be calculated under a cumulative household income which would not be to be represented in the automated formula. After realizing that the automated formula in SQL wouldn't work I came to the conclusion that I would need to manually calculate the Gross Debt Service Ratio. For this I created an excel spreadsheet with all of the information I would need, see Figure 5 . I added two sheets to the excel spreadsheet, one included the average property tax of properties in Ontario based on property value and the other states the average utilities costs these are the numbers used in the calculation of Gross Debt Service Ratio, see Figure 6 and Figure 7. I then manually calculated the Gross Debt Service Ratio for all mortgages and entered them into the GDS column on the property owners information sheet.

Figure 5: Excel spreadsheet including property owners information on the mortgage

ID	firstName	lastName	Address	Credit Score	Appraisal	Income	Principal	Annual Principal	GDS
1	Maria	Pollo	123 Butterfly Lane, Toronto, ON M8V 1A2	600	$ 875,000.00	$ 145,000.00	4769.14	57229.68	
2	John	Mendoza	987 Grasshopper Street, Toronto, ON M8V 9X0	700	$ 625,000.00	$ 76,000.00	3362	40344	
3	Robert	Miller	807 Watcher Park, Toronto, ON M1L 9U7	715	$ 950,000.00	$ 65,000.00	5137.47	61649.64	
4	Richard	O'Connor	345 Ashton Street, Toronto, ON M1L J2M	800	$ 575,000.00	$ 92,000.00	3363.68	40364.16	
5	James	Brown	345 Jackson Avenue, Toronto, ON M1L G6K	810	$ 220,000.00	$ 48,000.00	2748.9	32986.8	
6	Lisa	Brown	345 Jackson Avenue, Toronto, ON M1L G6K	870	$ 220,000.00	$ 78,000.00	2748.9	32986.8	
7	Brian	Donnally	123 Bulldog Drive, Toronto, ON M8V 9Z8	815	$ 490,000.00	$ 71,000.00	2157.41	25888.92	
8	Linda	Donnally	123 Bulldog Drive, Toronto, ON M8V 9Z8	640	$ 490,000.00	$ 6,300.00	2157.41	25888.92	
9	Karen	Miller	807 Watcher Park, Toronto, ON M1L 9U7	835	$ 690,000.00	$ 74,000.00	2417.93	29015.16	
10	Susan	Franko	428 Baxter Avenue , Toronto, ON M1L H8L	605	$ 850,000.00	$ 67,000.00	5012.05	60144.6	
11	Pierre	Graham	9649 Paxton Street, London, ON N5V 7N9	705	$ 450,000.00	$ 67,000.00	1389.2	16670.4	
12	Yvonne	Hansen	9684 Kent Street, London, ON N5V 5K2	520	$ 540,000.00	$ 46,000.00	317.94	3815.28	
13	Vincent	Hensen	9684 Kent Street, London, ON N5V 5K2	730	$ 540,000.00	$ 54,000.00	317.94	3815.28	
14	Paul	Judd	765 Baxter Street, Toronto, ON M1L 6N9	780	$ 250,000.00	$ 57,000.00	889.09	10669.08	
15	Paul	Judd	765 Baxter Street, Toronto, ON M1L 6N9	780	$ 300,000.00	$ 57,000.00	1166.92	14003.04	
16	Tina	Koffman	3861 Brampton Street, London, ON N5V 6N0	490	$ 980,000.00	$ 114,000.00	1095.86	13150.32	

Figure 6: Excel spreadsheet including average property taxes on properties in all cities of Ontario by property value

Cities	Residential Tax Rate	Taxes for your home's assessed value of $250,000	Taxes for your home's assessed value of $500,000	Taxes for your home's assessed value of $1,000,000
Toronto	0.60%	$1,589	$3,178	$6,355
Burlington	0.82%	$2,038	$4,076	$8,152
Ottawa	1.07%	$2,671	$5,342	$10,684
Mississauga	0.82%	$2,059	$4,117	$8,235
Waterloo	1.11%	$2,770	$5,539	$11,078
Kitchener	1.13%	$2,824	$5,649	$11,297
Hamilton	1.26%	$3,155	$6,310	$12,620
Guelph	1.17%	$2,928	$5,856	$11,713
London	1.35%	$3,377	$6,754	$13,508

Figure 7: Excel spreadsheet including average utilities cost in Ontario

Utility Costs in Ontario (2023)		
Utility	Average Monthly Cost	Average Yearly Cost
Electricity	$130	$1,560
Natural Gas	$51.42	$617
Other (Water, Internet, Cable, Home Phone)	$138.58	$1,663
Total	$320	$3,840

3.2 Gross Debt Service Ratio Calculations

$$GDS_1 = \frac{57229.68 + 6355 + 3840}{145000} = 0.46 = 46\%$$

$$GDS_2 = \frac{40344 + 3178 + 3840}{76000} = 0.62 = 62\%$$

$$GDS_3 = \frac{61649.64 + 6355 + 3840}{65000} = 1.10 = 110\%$$

$$GDS_4 = \frac{40364 + 3178 + 3840}{92000} = 0.51 = 51\%$$

$$GDS_{5,6} = \frac{32986 + 3178 + 3840}{78000 + 48000} = 0.31 = 31\%$$

$$GDS_{7,8} = \frac{25888 + 3178 + 3840}{71000 + 6300} = 0.42 = 42\%$$

$$GDS_9 = \frac{29015 + 3178 + 3840}{74000} = 0.48 = 48\%$$

$$GDS_{10} = \frac{60144 + 6355 + 3840}{67000} = 0.104 = 104\%$$

$$GDS_{11} = \frac{16670 + 6754 + 3840}{67000} = 0.40 = 40\%$$

$$GDS_{12,13} = \frac{3815.28 + 6754 + 3840}{54000 + 46000} = 0.14 = 14\%$$

$$GDS_{14,15} = \frac{(10699 + 14003) + (1589 + 1589) + 3840}{57000} = 0.62 = 62\%$$

$$GDS_{14} = \frac{10699 + 1589 + 3840}{57000} = 0.28 = 28\%$$

$$GDS_{15} = \frac{14003 + 1589 + 3840}{57000} = 0.34 = 34\%$$

$$GDS_{16} = \frac{13150 + 13508 + 3840}{114000} = 0.26 = 26\%$$

Figure 8: Excel spreadsheet including property owners information on the mortgage and their Gross Debt Service Ratio

ID	firstName	lastName	Address	Credit Score	Appraisal	Income	Principal	Annual Principal	GDS
1	Maria	Pollo	123 Butterfly Lane, Toronto, ON M8V 1A2	600	$ 875,000.00	$ 145,000.00	4769.14	57229.68	46%
2	John	Mendoza	987 Grasshopper Street, Toronto, ON M8V 9X0	700	$ 625,000.00	$ 76,000.00	3362	40344	62%
3	Robert	Miller	807 Watcher Park, Toronto, ON M1L 9U7	715	$ 950,000.00	$ 65,000.00	5137.47	61649.64	110%
4	Richard	O'Connor	345 Ashton Street, Toronto, ON M1L J2M	800	$ 575,000.00	$ 92,000.00	3363.68	40364.16	51%
5	James	Brown	345 Jackson Avenue, Toronto, ON M1L G6K	810	$ 220,000.00	$ 48,000.00	2748.9	32986.8	31%
6	Lisa	Brown	345 Jackson Avenue, Toronto, ON M1L G6K	870	$ 220,000.00	$ 78,000.00	2748.9	32986.8	31%
7	Brian	Donnally	123 Bulldog Drive, Toronto, ON M8V 9Z8	815	$ 490,000.00	$ 71,000.00	2157.41	25888.92	42%
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9	Karen	Miller	807 Watcher Park, Toronto, ON M1L 9U7	835	$ 690,000.00	$ 74,000.00	2417.93	29015.16	48%
10	Susan	Franko	428 Baxter Avenue, Toronto, ON M1L H8L	605	$ 850,000.00	$ 67,000.00	5012.05	60144.6	104%
11	Pierre	Graham	9649 Paxton Street, London, ON N5V 7N9	705	$ 450,000.00	$ 67,000.00	1389.2	16670.4	40%
12	Yvonne	Hansen	9684 Kent Street, London, ON N5V 5K2	520	$ 540,000.00	$ 46,000.00	317.94	3815.28	14%
13	Vincent	Hensen	9684 Kent Street, London, ON N5V 5K2	730	$ 540,000.00	$ 54,000.00	317.94	3815.28	14%
14	Paul	Judd	765 Baxter Street, Toronto, ON M1L 6N9	780	$ 250,000.00	$ 57,000.00	889.09	10669.08	28%
15	Paul	Judd	765 Baxter Street, Toronto, ON M1L 6N9	780	$ 300,000.00	$ 57,000.00	1166.92	14003.04	34%
16	Tina	Koffman	3861 Brampton Street, London, ON N5V 6N0	490	$ 980,000.00	$ 114,000.00	1095.86	13150.32	26%

Some notes to make for the calculations; For the principal + interest I used the mortgage payments obtained in Figure 4 multiplied by 12 to obtain the annual principal + interest on the mortgage. For the property taxes I referred to 'Canadian Property Taxes - By Province' at this link, this provided me with averages based on the city and the value of the property. Since this site provided me with averages of property's valued at $250,000, $500,000, and $1,000,000 I rounded the properties of the mortgage applicants to the nearest value then

used that average property tax, for example if the property was in Toronto and worth $850,000 I rounded up and used the average property tax on a property in Toronto worth $1,000,000. For the average utilities I used the article 'What is the average cost of utilities for a house in Ontario and why is it increasing?' at this link, from there I got the average cost of utilities per month as $320 which I then multiplied by 12 to get an annual cost for utilities for all properties in Ontario, see Figure 7. Using these numbers I calculated all Gross Service Debt Ratios then entered them into the excel spreadsheet, see Figure 8. For mortgages on the same property where the two individuals had the same last name I made the assumption it will be a joint mortgage and for the denominator I summed the household income, see $GDS_{5,6}$ as an example. For the case of one individual attempting to purchase two properties and applying for two mortgages, I summed the principal and property taxes for both properties and calculated the GDS ratio under one income, then calculated the GDS ratio for the individual properties to see whether the individual would be approved for a single property, see $GDS_{14,15}$, GDS_{14}, GDS_{15} as an example.

3.3 Conclusion

In conclusion, the individuals most likely to default based on their Gross Debt Service ratios are Robert Miller and Susan Franko [ID's 3 & 10 in Figure 8]. The Gross Debt Service Ratio I calculated for these individuals are both over 100% meaning that the cost of the property would be greater than the individuals annual income. Since the cost of the property would be greater than the individuals annual income it is very likely that these two individuals will default on thier mortgage payments. It is important to note that according to the article 'New CMHC rules may make mortgage applications tougher' which can be found through this link, due to COVID-19 the CMHC rules have been updated, The new requirements are:

- Gross debt service (GDS) ratios must be under 35, down from 39

- Total debt service (TDS) ratios must be under 42, down from 44

- Borrower's credit score must be at least 680, up from 620

- Borrowed down payments will no longer be allowed

Under these requirements most individuals on this list would not be eligible for the CMHC mortgage insurance. The individuals who would be eligible for the CMHC mortgage insurance are; James and Lisa Brown, Yvonne and Vincent Hensen, and Paul Judd(but only for one of the properties, not both). All other individuals either have a Gross Debt Service Ratio greater than 35% or have a credit score below 680.

Based on theses findings it is clear that it is wise to consider a joint mortgage if possible since when you sum the household annual income the denominator grows making the Gross Debt Service Ratio decrease and increasing the likelihood of being accepted for the mortgage.

4 Citations

- https://www.cmhc-schl.gc.ca/consumers/home-buying/calculators/mortgage-calculator

- https://www.cmhc-schl.gc.ca/consumers/home-buying/mortgage-loan-insurance-for-consumers/what-are-the-general-requirements-to-qualify-for-homeowner-mortgage-loan-insurance

- https://www.investopedia.com/terms/g/grossdebtserviceratio.asp:~text=The%20gross%20debt%20service%20(GDS,in%20comparison%20to%20their%20income.

- https://www.ratehub.ca/blog/new-cmhc-rules-covid-19/

- https://www.wealthsimple.com/en-ca/learn/canadian-property-taxes

- https://www.canadianrealestatemagazine.ca/expert-advice/what-is-the-average-cost-of-utilities-for-a-house-in-ontario-and-why-is-it-increasing-335134.aspx

- https://www.nesto.ca/calculators/cmhc-insurance/

- https://www.nesto.ca/mortgage-basics/debt-service-ratios-how-to-calculate-gds-and-tds/