

# GBM Internal Control – Records and Investigative Analytics (Associate)

## Candidate Assignment

Sep 25<sup>th</sup>, 2023:

- Downloaded all the JSON files from BOC website (Regular Treasury Bills, Cash Management Bills, Nominal Bonds, Ultra Long Bonds, Real Return Bonds, Cash Management Bond Buybacks)
- Put all the features into an excel sheet and mapped out which ones I wanted to keep/remove.
  - o Decided to keep any features/columns that were present on at least half of the files.
  - o Indicated which ones to keep in red.
  - o Delete the rest.

A	B	C	D	E	F	G	H	I	J	K
1 TBILL_C	TBILL	TBILL	BOND_U	BOND	BOND	BOND_R	BOND_R	BOND_R	BOND_R	BOND_R
2 Allotment ratio (%)	Allotment ratio (%)	Allotment ratio (%)	Allotment price	Allotment price	Allotment price	Allotment ratio (%)	Allotment ratio (%)	Allotment ratio (%)	Allotment ratio (%)	Allotment ratio (%)
3 Amount (\$M)	Amount (\$M)	Amount (\$M)	Allotment ratio (%)	Allotment ratio (%)	Allotment ratio (%)	Amount (\$M)	Amount (\$M)	Amount (\$M)	Amount (\$M)	Amount (\$M)
4 Auction date	Auction date	Auction date	Amount (\$M)	Amount (\$M)	Amount (\$M)	Auction date	Auction date	Auction date	Auction date	Auction date
5 Avg price	Avg price	Avg price	Auction date	Auction date	Auction date	Bidding deadline	Bidding deadline	Bidding deadline	Bidding deadline	Bidding deadline
6 Avg yield (%)	Avg yield (%)	Avg yield (%)	Bidding deadline	Bidding deadline	Bidding deadline	Coupon rate	Coupon rate	Coupon rate	Coupon rate	Coupon rate
7 Bidding deadline	Bidding deadline	Bidding deadline	Of which held by Bank of Canada (\$M)	Of which held by Bank of Canada (\$M)	Of which held by Bank of Canada (\$M)	Cutoff yield (%)	Cutoff yield (%)	Cutoff yield (%)	Cutoff yield (%)	Cutoff yield (%)
8 Of which held by Bank of Canada (\$M)	Of which held by Bank of Canada (\$M)	Of which held by Bank of Canada (\$M)	Bank of Canada purchase (\$M)	Bank of Canada purchase (\$M)	Bank of Canada purchase (\$M)	Accrued interest end date	Accrued interest end date	Accrued interest end date	Accrued interest end date	Accrued interest end date
9 Bank of Canada minimum purchase (\$M)	Bank of Canada purchase (\$M)	Bank of Canada purchase (\$M)	Coverage	Coverage	Coverage	Accrued interest rate per \$1000	Accrued interest rate per \$1000	Accrued interest rate per \$1000	Accrued interest rate per \$1000	Accrued interest rate per \$1000
10 Bank of Canada purchase (\$M)	Coverage	Coverage	High yield (%)	High yield (%)	High yield (%)	Bank of Canada minimum purchase (\$M)	Bank of Canada minimum purchase (\$M)	Bank of Canada minimum purchase (\$M)	Bank of Canada minimum purchase (\$M)	Bank of Canada minimum purchase (\$M)
11 Coverage	High yield (%)	High yield (%)	Issue date	Issue date	Issue date	Bank of Canada purchase (\$M)	Bank of Canada purchase (\$M)	Bank of Canada purchase (\$M)	Bank of Canada purchase (\$M)	Bank of Canada purchase (\$M)
12 High yield (%)	Issue date	Issue date	Coupon rate	Coupon rate	Coupon rate	Coupon rate	Coupon rate	Coupon rate	Coupon rate	Coupon rate
13 ISIN	Auction key	Auction key	Accrued interest end date	Accrued interest end date	Accrued interest end date	Accrued interest rate per \$1000	Accrued interest rate per \$1000	Accrued interest rate per \$1000	Accrued interest rate per \$1000	Accrued interest rate per \$1000
14 Issue date	Low yield (%)	Low yield (%)	Accrued interest start date	Accrued interest start date	Accrued interest start date	High yield (%)	High yield (%)	High yield (%)	High yield (%)	High yield (%)
15 Auction key	Maturity date	Maturity date	ISIN	ISIN	ISIN	Accrued interest end date	Accrued interest end date	Accrued interest end date	Accrued interest end date	Accrued interest end date
16 Low yield (%)	Total Non-Comp Submitted by GSD (\$M)	Total Non-Comp Submitted by GSD (\$M)	Issue date	Issue date	Issue date	Accrued interest rate per \$1000	Accrued interest rate per \$1000	Accrued interest rate per \$1000	Accrued interest rate per \$1000	Accrued interest rate per \$1000
17 Maturity date	Outstanding after (\$M)	Outstanding after (\$M)	Auction key	Auction key	Auction key	Accrued interest start date	Accrued interest start date	Accrued interest start date	Accrued interest start date	Accrued interest start date
18 Total non-comp submitted by GSD (\$M)	Outstanding prior (\$M)	Outstanding prior (\$M)	Low 5% yield (%)	Low 5% yield (%)	Low 5% yield (%)	ISIN	ISIN	ISIN	ISIN	ISIN
19 Outstanding after (\$M)	Status	Status	Maturity date	Maturity date	Maturity date	Issue date	Issue date	Issue date	Issue date	Issue date
20 Outstanding prior (\$M)	Tail (Bps)	Tail (Bps)	Median yield (%)	Median yield (%)	Median yield (%)	Low yield (%)	Low yield (%)	Low yield (%)	Low yield (%)	Low yield (%)
21 Status	Term (days)	Term (days)	Total Non-Comp Submitted by GSD (\$M)	Total Non-Comp Submitted by GSD (\$M)	Total Non-Comp Submitted by GSD (\$M)	Maturity date	Maturity date	Maturity date	Maturity date	Maturity date
22 Tail (Bps)	Total amount (\$M)	Total amount (\$M)	Outstanding after (\$M)	Outstanding after (\$M)	Outstanding after (\$M)	Total Non-Comp Submitted by GSD (\$M)	Total Non-Comp Submitted by GSD (\$M)	Total Non-Comp Submitted by GSD (\$M)	Total Non-Comp Submitted by GSD (\$M)	Total Non-Comp Submitted by GSD (\$M)
23 Term (days)	Total amount maturing (\$M)	Total amount maturing (\$M)	Outstanding including reconstituted (\$M)	Outstanding including reconstituted (\$M)	Outstanding including reconstituted (\$M)	Outstanding after (\$M)	Outstanding after (\$M)	Outstanding after (\$M)	Outstanding after (\$M)	Outstanding after (\$M)
24 Total amount maturing (\$M)	Total submitted by GSD (\$M)	Total submitted by GSD (\$M)	Outstanding prior (\$M)	Outstanding prior (\$M)	Outstanding prior (\$M)	Outstanding including reconstituted (\$M)	Outstanding including reconstituted (\$M)	Outstanding including reconstituted (\$M)	Outstanding including reconstituted (\$M)	Outstanding including reconstituted (\$M)
25 Total submitted by GSD (\$M)			Status	Status	Status	Outstanding prior (\$M)	Outstanding prior (\$M)	Outstanding prior (\$M)	Outstanding prior (\$M)	Outstanding prior (\$M)
26 Type			Term (years)	Term (years)	Term (years)	Status	Status	Status	Status	Status
27			Total amount maturing (\$M)	Total amount maturing (\$M)	Total amount maturing (\$M)	Term (years)	Term (years)	Term (years)	Term (years)	Term (years)
28			Total submitted by GSD (\$M)	Total submitted by GSD (\$M)	Total submitted by GSD (\$M)	Total amount maturing (\$M)	Total amount maturing (\$M)	Total amount maturing (\$M)	Total amount maturing (\$M)	Total amount maturing (\$M)
29			Bond issued via syndication vs auction	Bond issued via syndication vs auction	Bond issued via syndication vs auction	Total submitted by GSD (\$M)	Total submitted by GSD (\$M)	Total submitted by GSD (\$M)	Total submitted by GSD (\$M)	Total submitted by GSD (\$M)
30						Status	Status	Status	Status	Status
31										

- PyCharm work:
  - o Gather and download all the JSON URLs and store their data into a data frame.
  - o Add "Failed to retrieve data from URL: 'listed URL'" as error handling should one of the URLs not work, for those extra points 😊
  - o Tossed in a delete duplicate columns as preliminary.
  - o Removed \_KEY column as it was an exact duplicate of bond\_id and tbill\_id
  - o Merged bond\_id and tbill\_id into one ID column then dropped them.
  - o Merged all columns that aligned with each other into one singular column and dropped them.
  - o This cleaning/normalizing brought the total column count from 150->30.
  - o Removed any nan values.
  - o Got rid of the pesky dictionary keys.
  - o Saved to a new CSV Excel file.
  - o Looks good.
  - o Goodnight

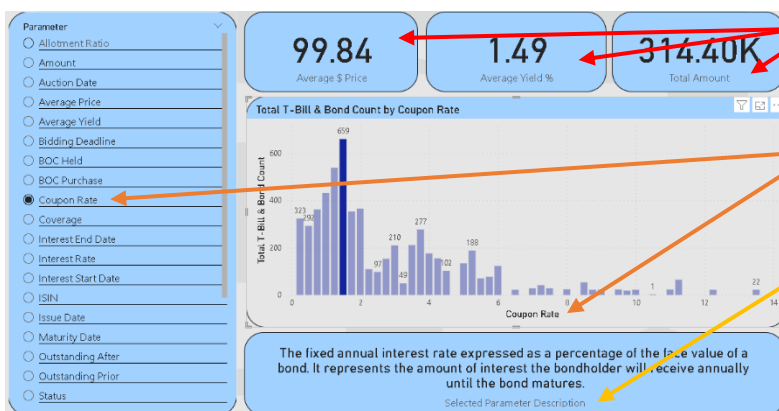
# Merged CSV

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	ID	AMOUNT	ISIN	ALLOTMENT RATIO	AUCTION DATE	AVERAGE PRICE	AVERAGE YIELD	MATURITY DATE	BIDDING DEADLINE	COVERAGE	HIGH YIELD	LOW YIELD	TAIL (BPS)	TERM (DAYS)	TERM (YEARS)	ISSUE DATE	OUTSTANDING PRIOR
2	HIST_TBILL_3	3300	CA135027M693		10/13/1998	98.76135	4.671	1/21/1999	12:30	1.946	4.685	4.665	1.4	98		10/15/1998	
3	HIST_TBILL_2	1500	CA135027M61		10/13/1998	97.43521	4.957	4/15/1999	12:30	1.603	4.88	4.834	2.3	182		10/15/1998	
4	HIST_TBILL_1	1400	CA135027M123		10/13/1998	95.44925	4.781	10/4/1999	12:30	1.368	4.8	4.74	1.9	364		10/15/1998	
5	HIST_TBILL_4	3300	CA135027M176		10/27/1998	98.74221	4.744	2/4/1999	12:30	1.755	4.754	4.732	0.97	98		10/29/1998	
6	HIST_TBILL_5	1500	CA135027M61		10/27/1998	97.84132	4.793	4/15/1999	12:30	1.754	4.82	4.77	2.65	168		10/29/1998	
7	HIST_TBILL_4	1400	CA135027M123		10/27/1998	95.65594	4.736	10/4/1999	12:30	1.935	4.748	4.725	1.2	350		10/29/1998	
8	HIST_TBILL_9	3300	CA135027M40		11/18/1998	98.71146	4.862	2/18/1999	12:30	1.507	4.88	4.844	1.82	98		11/12/1998	
9	HIST_TBILL_8	1500	CA135027M67		11/18/1998	97.98802	4.957	5/13/1999	12:30	1.959	4.969	4.943	1.22	182		11/12/1998	
10	HIST_TBILL_7	1400	CA135027M606		11/18/1998	95.32352	4.933	11/10/1999	12:30	1.697	4.949	4.919	1.61	263		11/12/1998	
11	HIST_TBILL_12	3100	CA135027M23		11/24/1998	98.72375	4.815	3/4/1999	12:30	1.12	4.822	4.808	0.72	98		11/26/1998	
12	HIST_TBILL_11	1500	CA135027M67		11/24/1998	97.77967	4.933	5/13/1999	12:30	2.162	4.949	4.924	0.95	168		11/26/1998	
13	HIST_TBILL_10	1400	CA135027M606		11/24/1998	95.46092	4.973	11/10/1999	12:30	1.614	4.986	4.958	1.31	349		11/26/1998	
14	HIST_TBILL_15	3300	CA135027M606		12/8/1998	98.75643	4.69	3/18/1999	12:30	1.579	4.707	4.675	1.67	98		12/10/1998	
15	HIST_TBILL_14	1500	CA135027M24		12/8/1998	97.6668	4.751	6/10/1999	12:30	2.11	4.798	4.78	0.7	182		12/10/1998	
16	HIST_TBILL_13	1400	CA135027M88		12/8/1998	95.39641	4.839	12/9/1999	12:30	1.815	4.85	4.816	1.11	364		12/10/1998	
17	HIST_TBILL_18	3300	CA135027M606		12/22/1998	98.74205	4.697	4/2/1999	12:30	1.723	4.705	4.688	0.78	99		12/23/1998	
18	HIST_TBILL_17	1500	CA135027M24		12/22/1998	97.8408	4.755	6/10/1999	12:30	2.323	4.767	4.746	1.23	169		12/23/1998	
19	HIST_TBILL_16	1400	CA135027M88		12/22/1998	95.56406	4.827	12/9/1999	12:30	2.429	4.833	4.822	0.65	351		12/23/1998	
20	HIST_TBILL_21	3600	CA135027M61		1/5/1999	98.77817	4.607	4/15/1999	12:30	1.815	4.614	4.6	0.73	98		1/7/1999	
21	HIST_TBILL_20	1500	CA135027M69		1/5/1999	97.70772	4.705	7/8/1999	12:30	2.029	4.715	4.698	1.02	182		1/7/1999	
22	HIST_TBILL_19	1500	CA135027M10		1/5/1999	95.42547	4.807	1/6/2000	12:30	2.164	4.815	4.802	0.84	364		1/7/1999	
23	HIST_TBILL_24	3800	CA135027M237		1/13/1999	98.76481	4.658	4/29/1999	12:30	1.566	4.667	4.65	0.89	98		1/21/1999	
24	HIST_TBILL_23	1600	CA135027M69		1/13/1999	97.65078	4.772	7/8/1999	12:30	1.827	4.785	4.752	1.31	168		1/21/1999	
25	HIST_TBILL_22	1600	CA135027M10		1/13/1999	95.54965	4.957	1/6/2000	12:30	2.02	4.963	4.947	0.59	250		1/21/1999	
26	HIST_TBILL_27	4000	CA135027M67		2/2/1999	98.74334	4.74	5/13/1999	12:30	1.843	4.744	4.732	0.44	98		2/4/1999	
27	HIST_TBILL_26	1800	CA135027M38		2/2/1999	97.6397	4.848	8/5/1999	12:30	2.123	4.85	4.845	0.2	182		2/4/1999	
28	HIST_TBILL_25	1700	CA135027M92		2/2/1999	95.34881	4.897	2/3/2000	12:30	2.278	4.902	4.861	0.51	364		2/4/1999	
29	HIST_TBILL_30	4200	CA135027M81		2/16/1999	98.71847	4.835	5/27/1999	12:30	1.481	4.848	4.819	1.32	98		2/18/1999	
30	HIST_TBILL_29	1900	CA135027M38		2/16/1999	97.77944	4.934	8/5/1999	12:30	1.714	4.942	4.927	0.77	168		2/18/1999	
31	HIST_TBILL_28	1800	CA135027M92		2/16/1999	95.41698	5.009	2/3/2000	12:30	1.764	5.02	4.998	1.06	350		2/18/1999	
32	HIST_TBILL_33	4400	CA135027M24		3/7/1999	98.67741	4.992	6/10/1999	12:30	1.924	4.998	4.984	0.56	98		3/4/1999	

R	S	T	U	V	W	X	Y	Z	AA	AB	AC
OUTSTANDING AFTER	STATUS	COUPON RATE	TOTAL AMOUNT MATURING	INTEREST END DATE	INTEREST START DATE	INTEREST RATE	BOC MIN REPURCHASE	BOC HELD	BOC PURCHASE	TOTAL AMOUNT SUBMITTED BY GSD	TOTAL NON COMPLETE SUBMITTED BY GSP
									825		
									200		
									175		
									825		
									225		
									200		
									825		
									200		
									175		
									825		
									200		
									175		
									750		
									150		
									150		
									700		
									150		
									700		
									150		
									150		
									725		
									175		
									150		
									800		
									175		
									700		
									800		
									---		

Sep 26<sup>th</sup>, 2023:

- PowerBI:



Added 3 important features to consider. Dynamically changes based on selected value.

Started with a Dynamic Slicer that adjusts the X-Axis/parameter of a bar Graph. Y Axis for total bonds&tills.

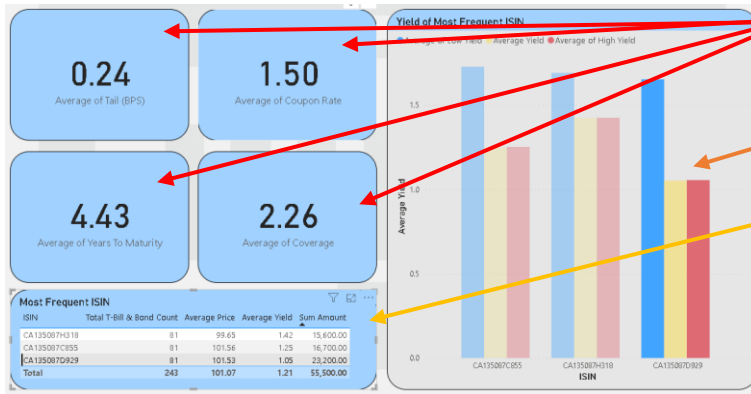
Added a text box that outputs information regarding the dynamic slicer so that the viewer is not confused regarding definitions.

Filtered out blanks from display.

- This page requires a new Field Parameter for the Dynamic Slicer and a DAX Measure for the total count of T-Bills/Bonds and for the Selected Parameter Description.
- I added a stock image of BOC to the canvas.
- Buttons added to change page.



- Made a page to display most frequent ISIN:



Put in 4 Cards with important features to consider. Cards change value based on selected ISIN.

Added a Bar Graph that indicated Average: Yield, Low Yield, and High Yield.

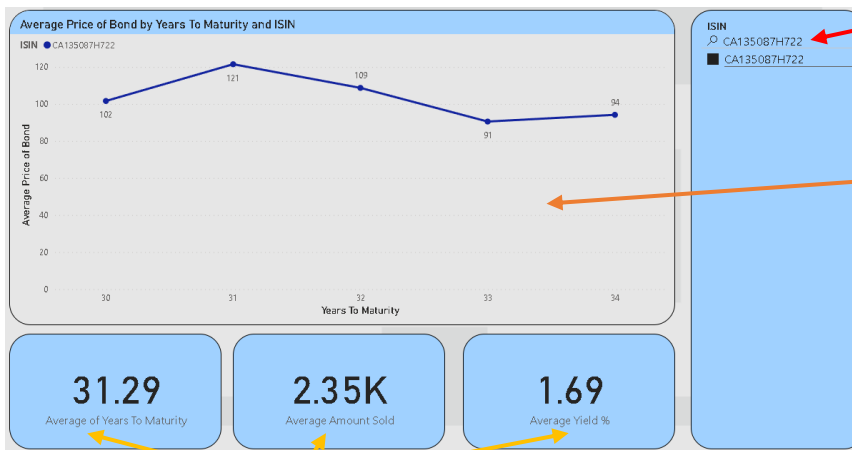
Table added. Utilized the previous Total DAX and sorted by TopN (1) to get the top count of ISIN. (Turns out there's multiple of them). Added the measures requested in assignment (ISIN, PRICE, YIELD, AMOUNT)

- Saved
- Goodnight

Sep 27<sup>th</sup>, 2023:

- PowerBI:

- Made a page specifically for filtering through ISIN:



Added Slicer for ISIN with a search bar to find specific ISIN. (Multiple ISIN selections possible as well)

Created a new column to get the Years to Maturity. DAX (Maturity-Issue). Added this to the X-Axis and Average Price to Y-Axis of a line chart. Chose the line chart due to the nature of the data as it is time related and somewhat continuous.

Added 3 relevant Cards to this that display the averages of Years to Maturity, Amount, and Yield.

- Based on the data shown of the selected ISIN Bond:

- Average Price of the Bond decreases as Years to Maturity Increases. This could be due to several factors including Interest Rate Risk, Opportunity Cost...

- Save finished PowerBI doc.

- Commit and Push entire project to GitHub.
- Convert this to PDF.
- Goodnight.