



BART Rolling Stock ABS Issuance

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[I. Background]

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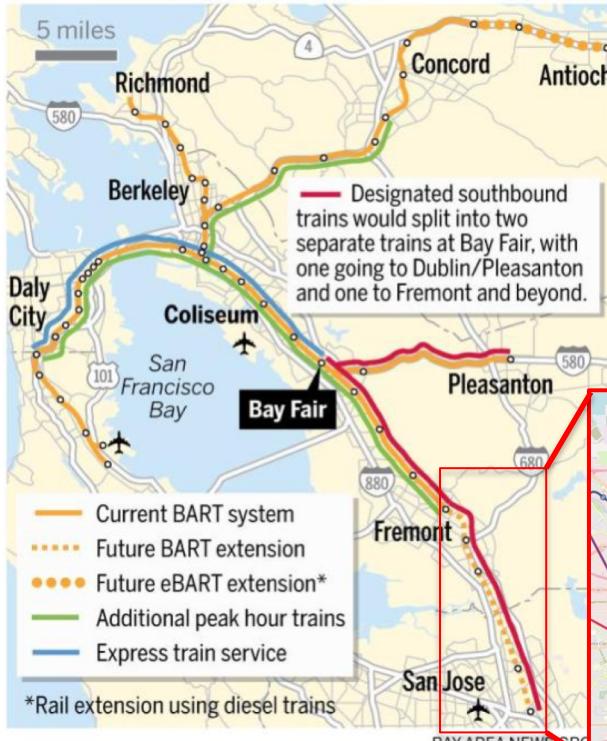


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{I. Background}

BART Expansion Plans

BART officials are considering several options that would allow 50 percent more passengers to use the system by 2025.



- Bart is expanding: South Fremont to Santa Clara
 - 10 mile (16km) extension to Berryessa
 - 6 miles (9.6km) extension to Downtown San Jose
 - Estimated completion: 2029~2033

- New rolling stocks are needed for the expansion plan
 - Rolling stock: “cars” on the railroad



BART Has Scarcity In Cars

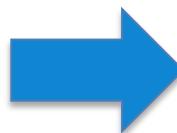
⟳ Car Replacement

New BART train cars needed as current ones have reached the end of their useful life. By February 2020, BART anticipates having enough new cars to lengthen nearly all period Transbay trains to 10 cars and to remove the least reliable legacy cars from service.

☒ Transbay Capacity Relief

BART currently operates 23 trains per hour (213 cars) in each direction through the Transbay Tube between San Francisco and Oakland during the peak hour. It is planning on increase train frequencies by more than 30%, and overall capacity by approximately 45%.

igsaw puzzle piece BART Expansion Plans



Total Cars needed as of 2019:

425 (1200 with 775 already under contract for purchasing)

Total Funds needed as of 2019:

\$1,566,000,000

Funding Methods

- **Currently: General Obligation Bonds (GO)**

- Repayment of the bonds is guaranteed with any means necessary, including fares, parking income, assets, etc.
- Action required immediately (most of the time) in the case of default
- BART has been using debt service allocations for existing bonds to fund labor costs and this has led to talk of voter deceit

- **Introducing: ABS backed by lease payments**

- Funded by lease payments of cars to be purchased

- More clear financial structure

- Construction of SPV - reduce balance sheet pressure and total liability for BART as a whole



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[II. Security Design]

Overview

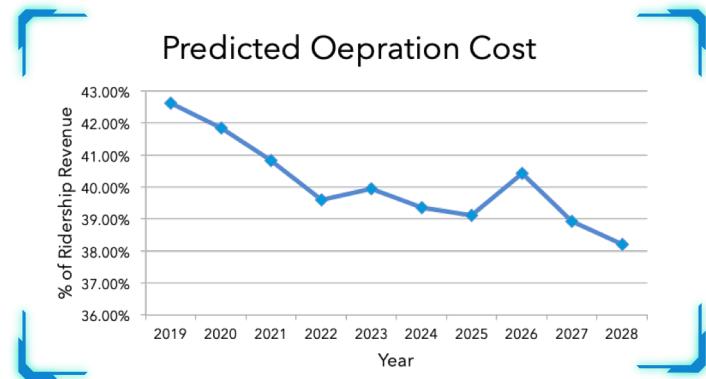
- **Data Source**: All data collected from BART official website
- **Funding source**: BART fare revenue (fare*ridership)
- **N of tranches**: 5 + residual
- **Waterfall Structure**
- **Coupon Rate**: 2.64% + spread
- **Price**: PAR

Tranches	Principal Amount (in \$1,000)	Base Rate + Spread
A1	313,200	2.70%
A2	313,200	2.80%
M1	313,200	3.00%
M2	313,200	3.20%
M3	313,200	3.40%
R	0	-

Variable	Historical Data	Prediction Period	Modeling Method
Ridership	Jan.2015 - Dec. 2018	180 mo.	SARIMA
Fare	Jan.. 2008 - Dec. 2018	180 mo.	Distribution

Assumptions & Clauses

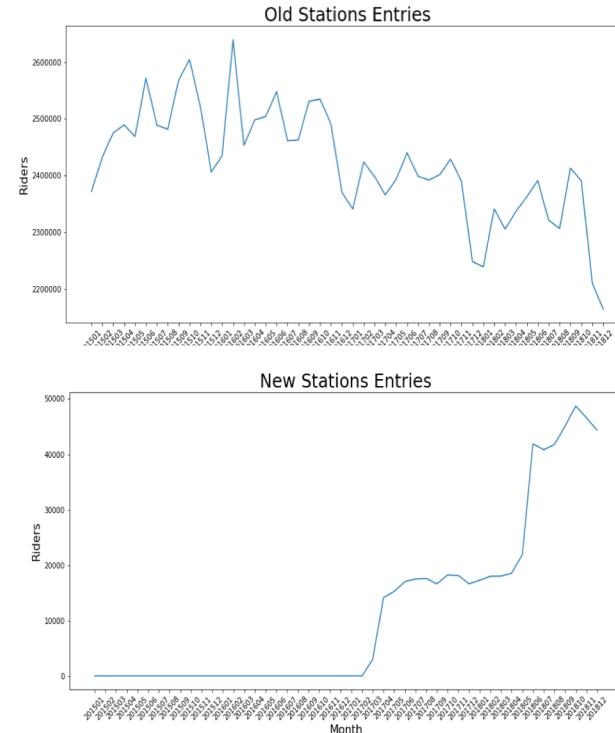
- Phase II and Phase III cars (425 cars total) are to be **purchased today**.
- Newly opened BART stations will follow **similar trend** in terms of ridership as existing stations.
- **No dramatic changes** in the BART system
- 60% of ridership revenue will be used to fund the ABS
 - On average, 40% of total revenue has to be paid to non-labor operational costs such as rail expense.



Ridership

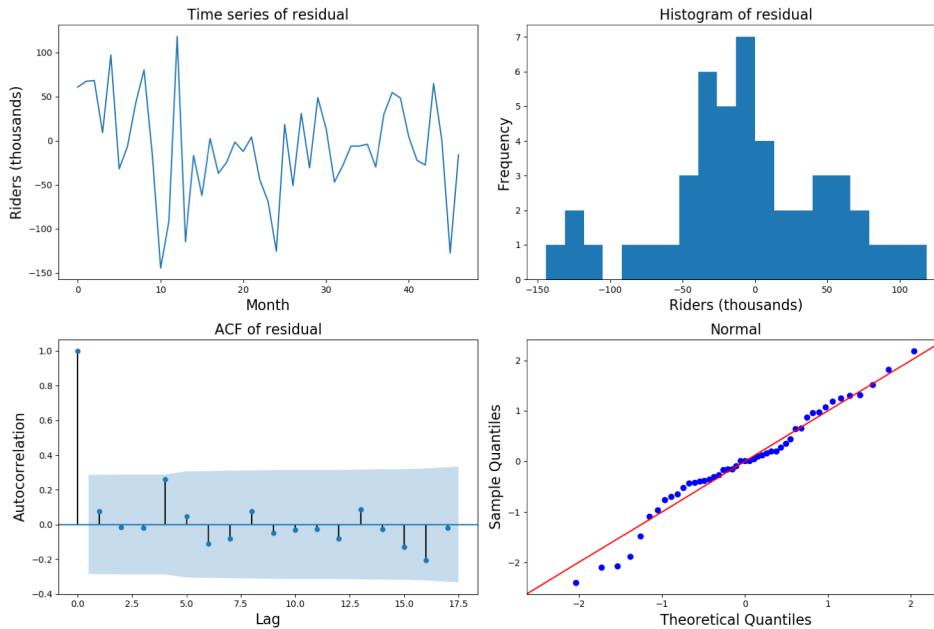
1. Historical BART ridership by station

- Clear **seasonality** throughout the year
- Overall **declining trend** for ridership
- New station data doesn't appear until February, 2017
- Using old station data, take first difference for **stationary** data to fit SARIMA



Ridership - cont.

2. Fitting SARIMA For Ridership

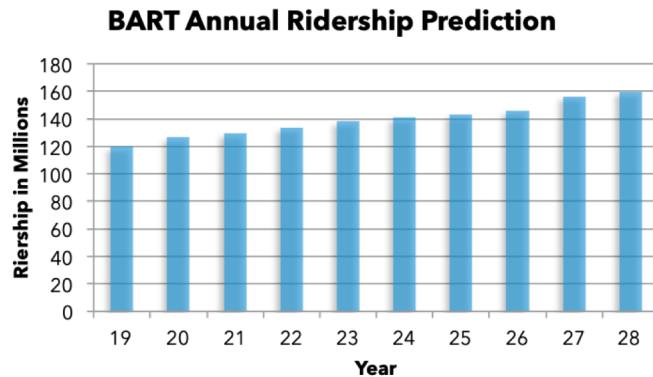


SARIMA($p=2, d=0, q=0 \mid P=1, D=1, Q=0$)

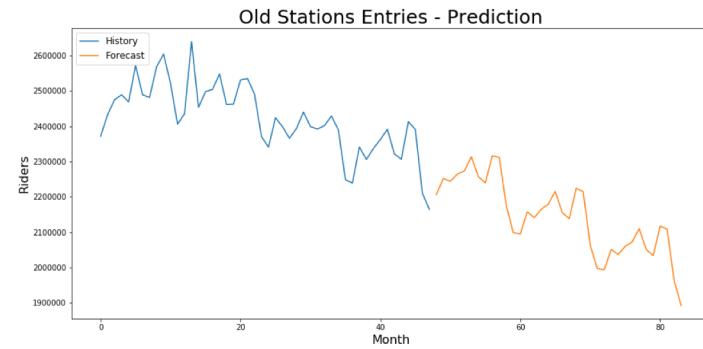
- Performed on the difference between average number of riders entering stations of current month and the next month
- Number of lags are decided based on ACF and residual graphs
 - ACF shows no significant lag at 95% confidence interval
 - Residual seems normal enough

Ridership - cont.

3. Consideration of Official BART Prediction



VS



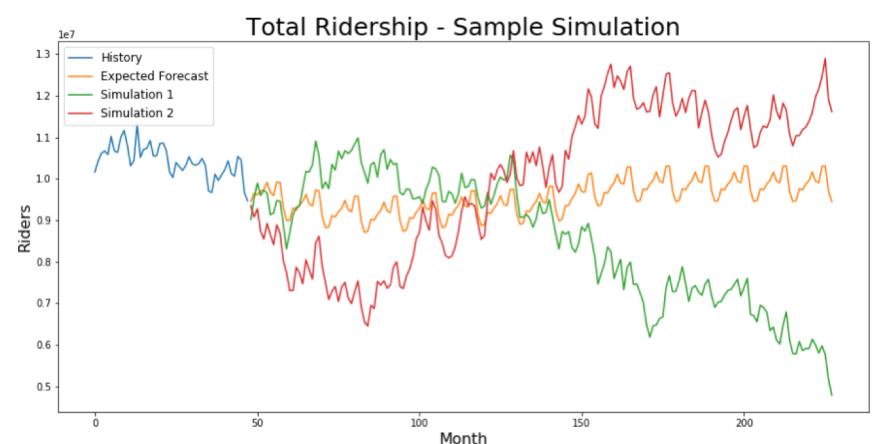
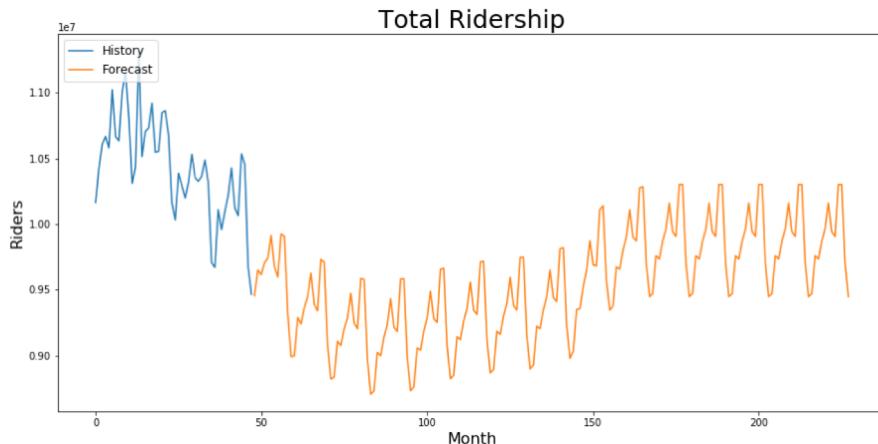
- BART is very optimistic about their future. However, We believe it is unlikely to reverse current downward trend.....
 - Due to the effect of rideshares such as **Uber** and **lyft**
 - BART's satisfaction rate has been decreasing dramatically for years
- But ridership cannot decline forever - it will eventually come back



Ridership - cont.

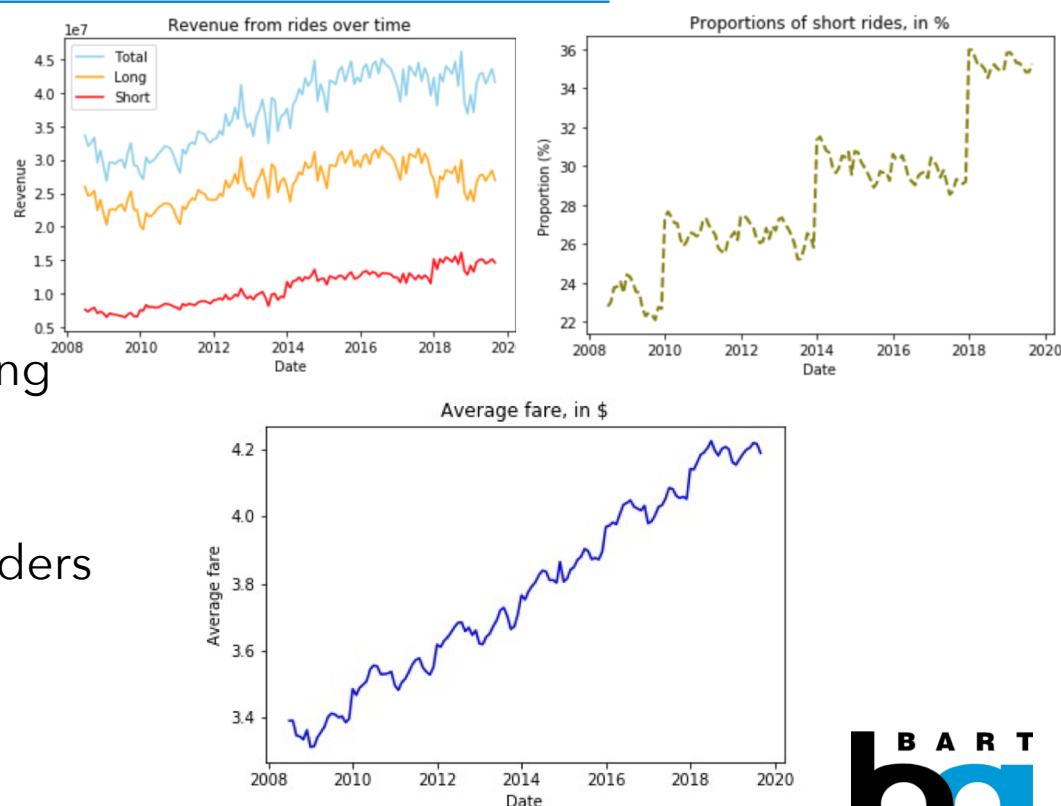
4. Final Result

- **Weighted average** of BART official prediction and our model result
 - Smaller weights on BART official numbers in the more recent years
 - Larger weights in the later years
- After 2028, it is hard to predict any potential trend – **constant ridership**



Fare

- Historical fare adjustments:
 - 2016: 3.4%
 - 2018: 2.7%
 - **3% increase every 2 years**
- Break riders into 2 categories: long dist and short dist
- Analyze proportion and revenue contribution of each portion of riders
- Simulate average fare from fare distribution





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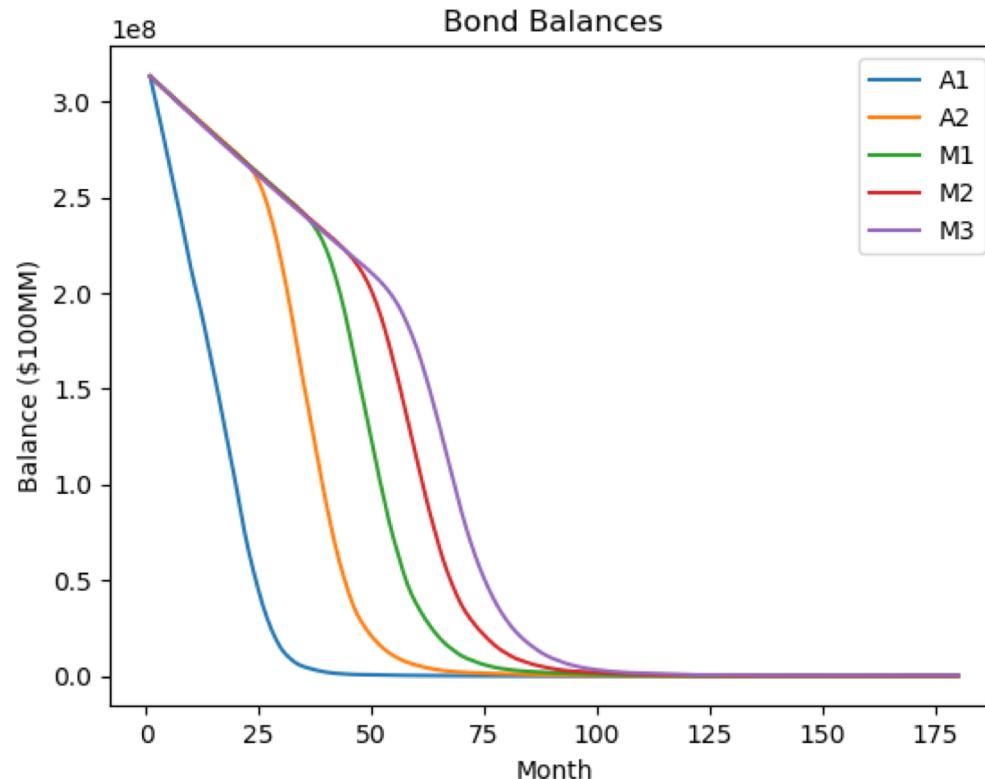
III. Bond Balance

Discount Rate Modeling

- Rate: LIBOR rate + spread
 - Different spread for each coupon
- LIBOR: calibrated with Hull-White Model
- $dr(t) = (\theta(t) - \kappa r(t))dt + \sigma dW(t)$
 - $dt = 1/12$ (monthly)
 - $B(t_{i-1}, t_i) = \frac{1-e^{-\kappa\tau_i}}{\kappa}$, $\tau = t_i - t_{i-1}$
 - $\sigma_p^i = B(t_{i-1}, t_i) * \sigma * \sqrt{\frac{1-e^{-2\kappa(t_{i-1}-t_i)}}{2\kappa}}$
 - $d_1 = \frac{\ln(\frac{f^L(t, t_{i-1}, t_i)}{X})}{\sigma_p \sqrt{t_{i-1}}} + \frac{1}{2} \sigma_p \sqrt{t_{i-1}}$, X is the swap rate
 - $d_2 = d_1 - \sigma_p \sqrt{t_{i-1}}$



Bond Balance and Results



Tranche Pricing Results

Tranches	Average Price (\$)	Std. Dev. (\$)	Std. Error (\$)
A1	317,774,500.00	3,124,211.00	139,718.97
A2	316,524,000.00	2,524,332.00	112,891.57
M1	312,945,800.00	3,262,457.00	145,901.51
M2	310,326,300.00	3,368,751.00	150,655.14
M3	308,429,400.00	3,785,663.00	169,300.01

Residual Class: -\$3.38
Total fund raised from all tranches: \$1.566 Billion



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{IV. Discussion}

Pros and Cons

Pros

Easy issuance procedure

No voting required by the community like GO bonds

Less Pressure for BART management on payment schedule

Attracting more investors with tranches

Incentive to increase revenue for BART

Holding R bond

Cons

? Forecasting for a long period of time - enormous amount of **uncertainty**

? Revenue amount, interest risk, etc.

? Active management may be required to insure sufficient cash flow

? Potential push back from the labor union



Future Improvements

- Additional research about future BART revenue volatility
 - Potential expansion plans, overall Bay Area development
 - Management style research at BART
 - Outside factors: population and demographics, sentiment regarding BART, rideshare potentials, etc.
- More information regarding labor union participation at BART



Q&A

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Thank you!

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