ROBERT H. SMITH
SCHOOL OF BUSINESS

BUDT703: Database Management Systems

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MENTOR: Prof. Adam Lee

Team OnTrack Analytics

Mission Statement:

Our mission is to analyze Amtrak's on-time performance over the past three fiscal years to uncover key insights into travel trends, identify growth opportunities, and develop strategies for enhancing ridership across the network

Mission Objectives:

- To analyze the on-time performance of states over a three-year period (2021, 2022, 2023) and determine which states consistently perform the best
- To analyze the relationship between ridership levels and Amtrak Guest Rewards enrollment to understand loyalty trend alignment with passenger volume
- To examine the relationship between staffing and on time performance reliability by analyzing employment trends in high-performing states.
- To evaluate the correlation between budget allocations and ridership levels at different stations to ensure resource efficiency.

OnTrack Analyst:

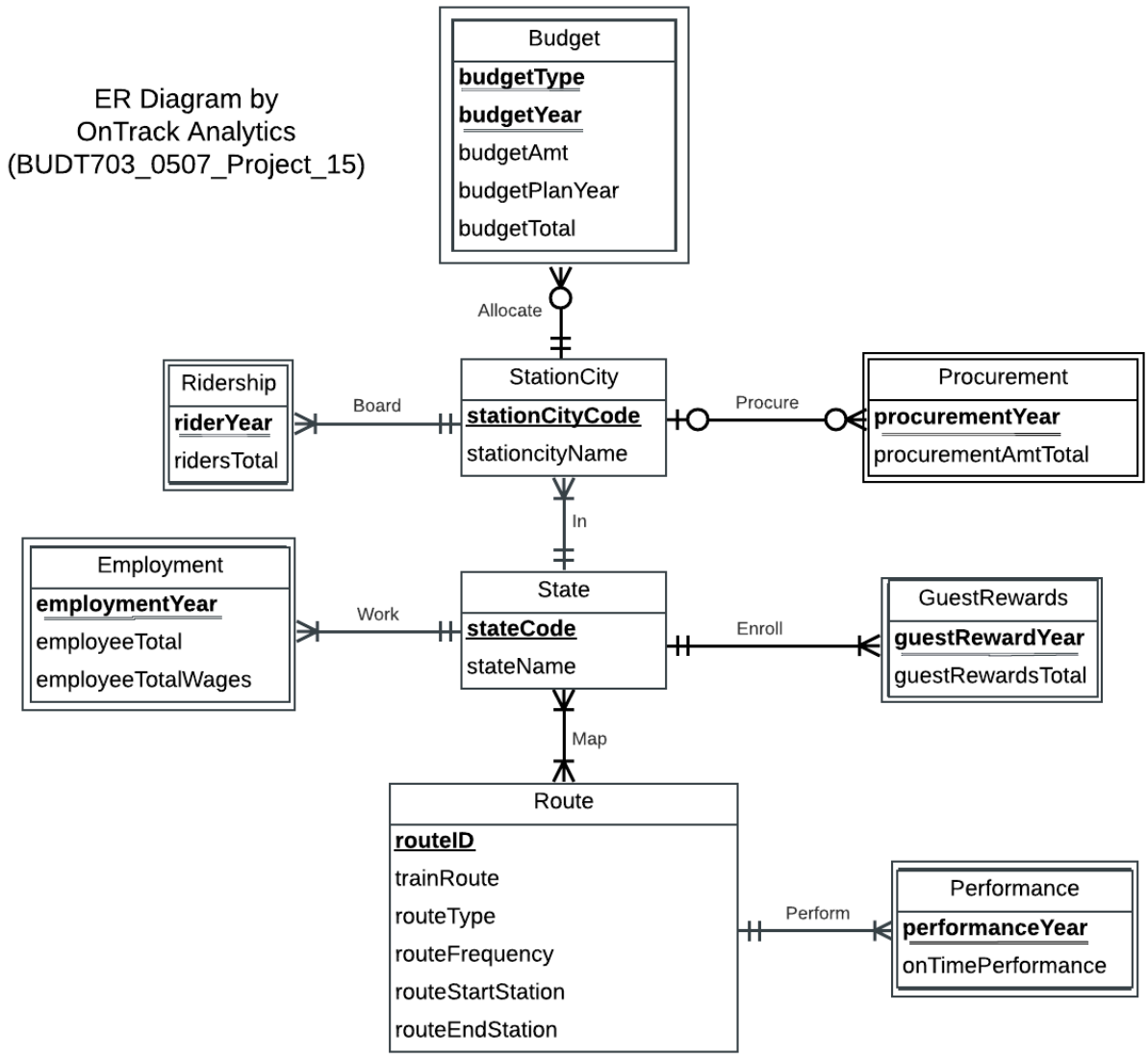
OnTrack Analytics is a consultant group with 4 employees, commissioned by the Amtrak team to create a database to analyze the performance over the years. Amtrak is responsible for passenger rail service, route management, and operational planning across the United States.

Business terms, Facts and Identifiers:

- Each station city is described by a unique stationCityCode and stationCityName, which are associated with a specific state using stateCode.
- Amtrak tracks budget planning for each station city. Each budget is identified by its type (design, construction and deployment) and includes attributes such as the year of allocation, the allocated amount, the planned budget for the next year, and the total utilized amount for that year.
- Procurement expenditures are recorded annually for each station city, described by the year and the total expenditure for that year.
- Ridership statistics are tracked yearly for each station city and include the total number of passengers for that year.
- Each state is identified by a unique state code and its name, representing the states where Amtrak operates.
- Each train route is identified by a unique route ID, and further described by the route type, frequency, starting station, and ending station and state code, representing the state where the route primarily operates.
- Amtrak tracks on-time performance for each route annually as a percentage of trains that arrived on time.
- Employment data is recorded yearly, including the total number of employees and the total wages paid during that year.

- Amtrak also tracks rewards issued to customers for loyalty programs in each state, recorded annually with the total rewards issued for that year.
- Amtrak maintains a route mapping system where a route can go through multiple states, and a single state can be associated with multiple train routes. This relationship is tracked using stateCode and routeID

ERD Diagram:



Relational Schema:

State(**stateCode**, stateName)

StationCity(**stationCityCode**, stationCityName, *stateCode*)

Route(**routeID**, trainRoute routeType, routeFrequency, routeStartStation, routeEndStation*)*

Performance*(**routeID**,* **performanceYear**, onTimePerformance)

Map(***stateCode** , routeID*)

Employment(***stateCode***, **employmentYear**, employeeTotal, employeeTotalWages)

GuestRewards(***stateCode***, **guestRewardsYear**, guestRewardsTotal)

Ridership(***stationCityCode***, **riderYear**, ridersTotal)

Procurement(***stationCityCode***, **procurementYear**, procurementAmtTotal)

Budget(***stationCityCode***, **budgetType**, **budgetYear**, budgetAmt, budgetPlanYear, budgetTotal)

Business Rules for relational integrity:

Business Rules:

[R1] If a state is deleted, no action will be taken for associated station cities, meaning cities in that state will remain with the existing state information

[R2] If a state code is updated, the related station city records should reflect the change to maintain consistency

[R3] If a state is deleted, all associated employment records should be deleted (CASCADE), as employment data in that state is no longer valid.

[R4] If a state code is updated, the related employment records should also update to reflect this change.

[R5] If a state is deleted, the station state field in related guest rewards records will remain unchanged.

[R6] If a state code is updated, the related guest rewards records should also update to reflect this new state code.

[R7] If a station city is deleted, all ridership records for that city should be deleted (CASCADE) because they are dependent on the city's existence.

[R8] If a city code is updated, the related ridership records should also update to maintain consistency with the new city code.

[R9] If a station city is deleted, all procurement records related to that city are deleted (CASCADE), as they are directly tied to the city's operations.

[R10] If a city code is updated, the related procurement records should also update to reflect the change.

[R11] If a station city is deleted, the associated budget records will also be deleted, as budget allocations are specific to the station.

[R12] If a city code is updated, the related budget records should also update to reflect the new city code.

[R13] If a route is deleted, the associated performance will also be deleted, as performance is specific to the route.

[R14] If a route is updated, the related performance should also be updated to reflect the efficiency of the new route.

[R15] If a route is deleted, associated map entries are not to be deleted to maintain data integrity and prevent loss of related information.

[R16] When a route's information is updated, the associated map entries must reflect the updated routeID

[R17] State cannot be deleted if it has associated map entries (NO ACTION) to ensure data integrity.

[R18] When a state's information is updated, the associated map entries must reflect the updated stateCode

Referential Integrity Actions:

Relation	**Foreign Key**	**Base Relation**	**Primary Key**	**Business Rule**	**ON DELETE**	**Business Rule**	**ON UPDATE**
StationCity	stateCode	State	stateCode	R1	NO ACTION	R2	CASCADE
Employment	stateCode	State	stateCode	R3	CASCADE	R4	CASCADE
GuestRewards	stateCode	State	stateCode	R5	NO ACTION	R6	CASCADE
Ridership	stationCityCode	StationCity	stationCityCode	R7	CASCADE	R8	CASCADE
Procurement	stationCityCode	StationCity	stationCityCode	R9	CASCADE	R10	CASCADE
Budget	stationCityCode	StationCity	stationCityCode	R11	CASCADE	R12	CASCADE
Performance	routeID	Route	routeID	R13	CASCADE	R14	CASCADE
Map	routeID	Route	routeID	R15	NO ACTION	R16	CASCADE
Map	stateCode	State	stateCode	R17	NO ACTION	R18	CASCADE

Sample Table Data View:

- ***STATE TABLE:***

Sample Data:

	State	State Code	SQL Code
2	Alabama	AL	('AL', 'Alabama'),
3	Arizona	AZ	('AZ', 'Arizona'),
4	Arkansas	AR	('AR', 'Arkansas'),

- ***STATION-CITY TABLE:***

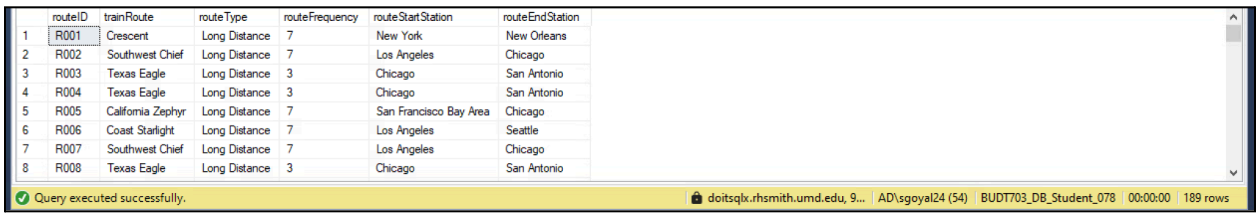
Sample Data:

	stationCityCode	stationCityName	stationCityCode	SQL CODE
2	ATN	Anniston	ATN	('ATN','Anniston','AL'),
3	BHM	Birmingham	BHM	('BHM','Birmingham','AL'),
4	TCL	Tuscaloosa	TCL	('TCL','Tuscaloosa','AL'),

- ***ROUTE TABLE:***

Sample Data:

	Route ID	Train Route	Route Type	Route Freque	Route Start Station	Route End Station	State Code	SQL_CODE
2	R011	Hartford Line	State Support	7	New Haven	Springfield	CT	('R011','Hartford Line','State Supported',7,'New Haven','Springfield'),
3	R012	Valley Flyer	State Support	7	New Haven	Greenfield	CT	('R012','Valley Flyer','State Supported',7,'New Haven','Greenfield'),



- ***PERFORMANCE TABLE:***

Sample Data:

	RouteID	Year	Value	SQL CODE
2	R001	2021	54.6	('R001',2021,54.6),
3	R001	2022	53	('R001',2022,53),
4	R001	2023	57	('R001',2023,57),

	routeID	performanceYear	onTimePerformance
1	R001	2021	54.6
2	R001	2022	53.0
3	R001	2023	57.0
4	R002	2021	36.3
5	R002	2022	28.0
6	R002	2023	34.0
7	R003	2021	52.0
8	R003	2022	49.0

Query executed successfully. | doitsqlx.rhsmith.umd.edu, 9... | AD\sgoyal24 (54) | BUDT703_DB_Student_078 | 00:00:00 | 567 rows

- ***MAP TABLE:***

Sample Data:

	Route ID	State Code	SQL CODE
2	R001	AL	('R001','AL'),
3	R002	AZ	('R002','AZ'),
4	R003	AZ	('R003','AZ'),

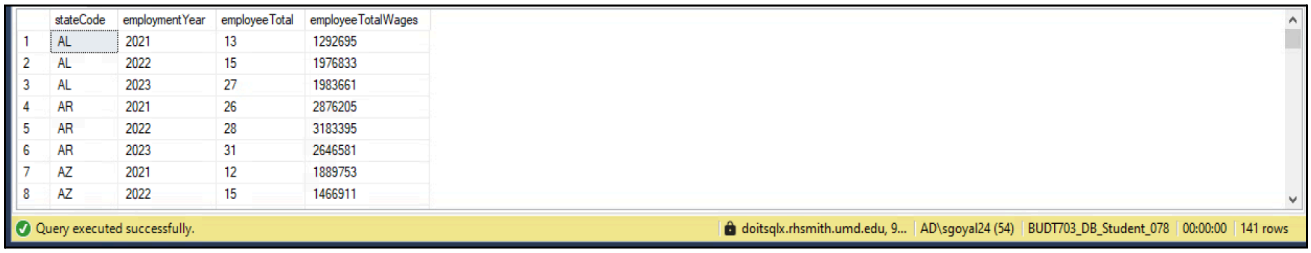
	routeID	stateCode
1	R001	AL
2	R004	AR
3	R002	AZ
4	R003	AZ
5	R164	AZ
6	R005	CA
7	R006	CA
8	R007	CA

Query executed successfully. | doitsqlx.rhsmith.umd.edu, 9... | AD\sgoyal24 (54) | BUDT703_DB_Student_078 | 00:00:00 | 189 rows

- ***EMPLOYMENT TABLE:***

Sample Data:

	State Code	Year	Value	SQL CODE
2	AL	2021	1292695	('AL',2021,13,1292695),
3	AL	2022	1976833	('AL',2022,15,1976833),
4	AL	2023	983661	('AL',2023,27,1983661),



	stateCode	employmentYear	employeeTotal	employeeTotalWages
1	AL	2021	13	1292695
2	AL	2022	15	1976833
3	AL	2023	27	1983661
4	AR	2021	26	2876205
5	AR	2022	28	3183395
6	AR	2023	31	2646581
7	AZ	2021	12	1889753
8	AZ	2022	15	1466911

Query executed successfully. | doitsqlx.rhsmith.umd.edu, 9... | AD\sgoyal24 (54) | BUDT703_DB_Student_078 | 00:00:00 | 141 rows

- ***GUEST REWARDS TABLE:***

Sample Data:

	state code	Year	Value	SQLCODE
2	AL	2021	36069	('AL',2021,36069),
3	AL	2022	50452	('AL',2022,50452),
4	AL	2023	58084	('AL',2023,58084),

	stateCode	guestRewardsYear	guestRewardsTotal
1	AL	2021	36069
2	AL	2022	50452
3	AL	2023	58084
4	AR	2021	21101
5	AR	2022	26133
6	AR	2023	29331
7	AZ	2021	75061
8	AZ	2022	93961

Query executed successfully. | doitsqlx.rhsmith.umd.edu, 9... | AD\sgoyal24 (54) | BUDT703_DB_Student_078 | 00:00:00 | 141 rows

- ***RIDERSHIP TABLE:***

Sample Data:

	City Code	Year	Value	SQL Code
2	ATN	2021	1948	('ATN',2021,1948),
3	ATN	2022	2486	('ATN',2022,2486),
4	ATN	2023	3459	('ATN',2023,3459),

	stationCityCode	riderYear	ridersTotal
1	ABE	2021	13841
2	ABE	2022	32935
3	ABE	2023	42671
4	ABQ	2021	25821
5	ABQ	2022	41692
6	ABQ	2023	51328
7	ACA	2021	19035
8	ACA	2022	24262

Query executed successfully. | doitsqlx.rhsmith.umd.edu, 9... | AD\sgoyal24 (54) | BUDT703_DB_Student_078 | 00:00:00 | 1,575 rows

- ***PROCUREMENT TABLE:***

Sample Data:

	StationCityCode	Year	ProcurementAmtTotal	SQLCode
2	ABE	2021	0	('ABE',2021,0),
3	ABE	2022	0	('ABE',2022,0),
4	ABE	2023	126798	('ABE',2023,126798),

	stationCityCode	procurementYear	procurementAmtTotal
1	ABE	2021	0
2	ABE	2022	0
3	ABE	2023	126798
4	ADM	2021	822500
5	ADM	2022	1012875
6	ADM	2023	0
7	ALT	2021	145665
8	ALT	2022	0

Query executed successfully. | doitsqlx.rhsmith.umd.edu, 9... | AD\sgoyal24 (54) | BUDT703_DB_Student_078 | 00:00:00 | 492 rows

- ***BUDGET TABLE:***

Sample Data:

	StationCityCode	Type	BudgetYear	BudgetAmt	Plan Year	Budget Total	SQLCODE
2	ATL	Design	2022	658	2016	709	('ATL','Design',2022,658,2016,709),
3	ATL	Design	2023	0	2016	709	('ATL','Design',2023,0,2016,709),
4	ATL	Design	2024	51	2016	709	('ATL','Design',2024,51,2016,709),

	stationCityCode	budgetType	budgetYear	budgetAmt	budgetPlanYear	budgetTotal
1	ABE	Design	2022	442	2017	1165
2	ABE	Design	2023	608	2017	1165
3	ABE	Design	2024	56	2017	1165
4	ABE	Design	2025	58	2017	1165
5	ABE	Design	2026	0	2017	1165
6	ABQ	Design	2022	0	2023	0
7	ABQ	Design	2023	0	2023	0
8	ABQ	Design	2024	300	2023	0

Query executed successfully. doitsqlx.rhsmith.umd.edu, 9... AD\sgoyal24 (54) BUDT703_DB_Student_078 00:00:00 1,228 rows