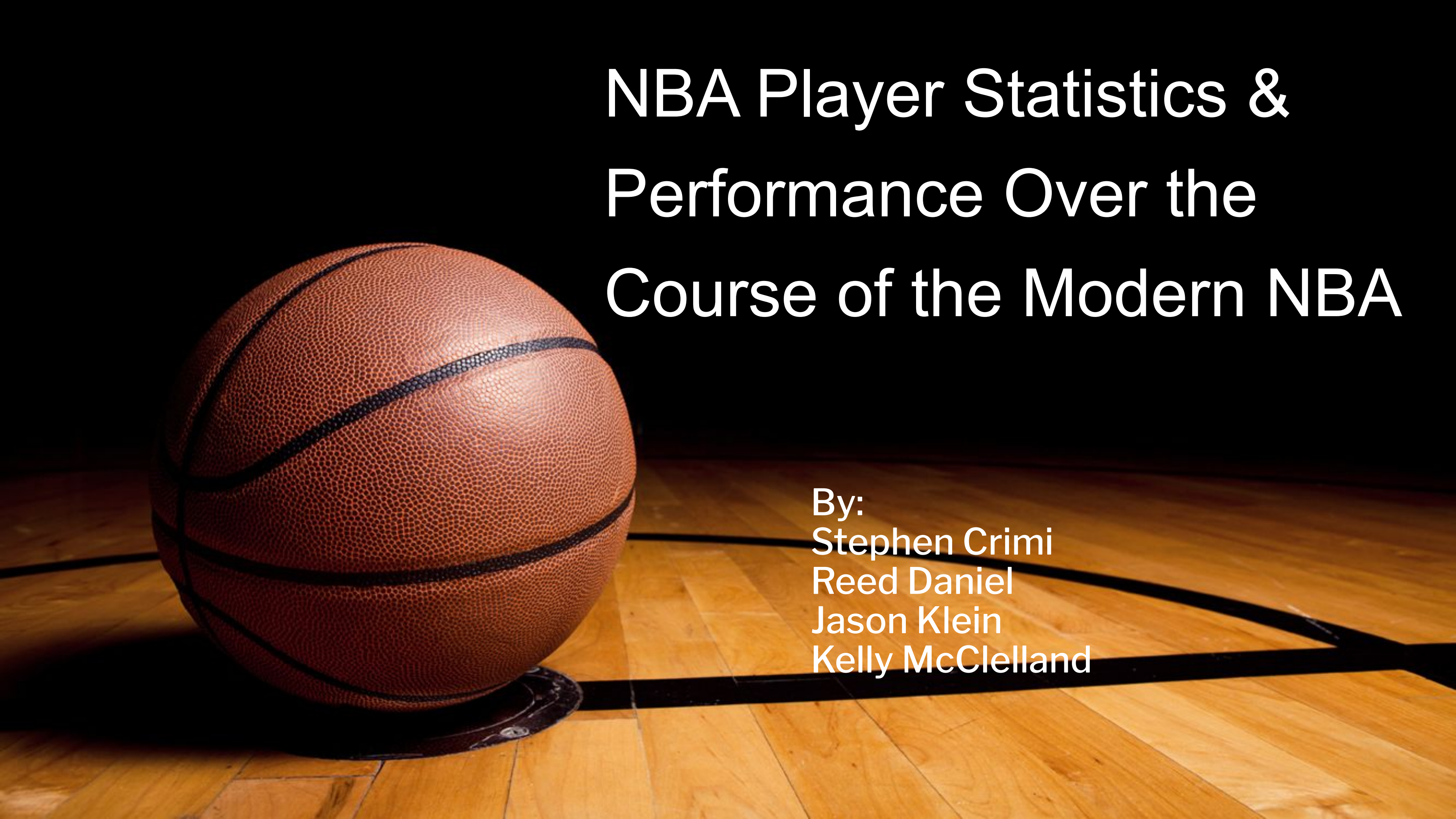

NBA Player Statistics & Performance Over the Course of the Modern NBA

By:
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Topic:

The relationship between NBA player statistics and performance over the course of the modern NBA

Reason for selecting the topic:

We would like to explore statistical data to determine if the NBA has a baseline for its athletes, how that baseline weighs against the top performers throughout the decades, and if you can predict the number of games a player would play per season.

Source Data

- Our source data is from Kaggle and includes NBA Players Stats since 1950 in the form of .csv files.

File Name	Number of Rows	Number of Columns
Player.csv	3,922	8
Season_Stats.csv	24,690	52
Player_Data.csv	4,550	8
NBA_Players_AllStars_All.csv	943	7

- For purpose of our analysis we will only focus on years 1980 to present as that is when the “modern” NBA began.

File Name	Number of Rows	Number of Columns
player_df.shape	3,919	7
seasons_df_shape	18,297	52
per_game_df.shape	18,297	11

Questions to Answer

- Does the NBA look the same decade by decade in terms of performance?
- What does a prototypical player look like in each decade?
  - How has that change over time?
- Can you predict whether an NBA player can be an All Star?
  - What are the most important stats in terms of determining an NBA All Star?

Project and Communication Protocols

- Our group maintains a steady flow of communication through Slack and our Teams page to stay updated on the status of the project deliverables as well as to coordinate additional meetings outside of class time.
- GitHub
  - The main branch should include:
    - All code necessary to perform exploratory analysis
    - Some code necessary to complete the machine learning portion of the project
    - README.md must include:
      - Description of the communication protocols
      - Outline of the project (this may include images, but should be easy to follow and digit). (Note: The descriptions and explanations required in all other project deliverables should also be in your README.md as part of your outline, unless otherwise noted.
    - Individual Branches
      - Description of the communication protocols
      - At least one branch for eah team member
      - Eash team member has at least four commits for the duration of the second segment (eight total commits per person)

Project and Communication Protocols (con'td)

Responsibility Legend	Symbol	Team Member	Systems	Phase
The team member in the square role will be responsible for the repository	□	K. McClelland	GitHub Teams Calendar	I & II
The member in the triangle role will create a mockup of a machine learning model. This can even be a diagram that explains how it will work concurrently with the rest of the project steps.	Δ	S. Crimi	Machine Learning	I & II
The member in the circle role will create a mockup of a database with a set of sample data, or even fabricated data. This will ensure the database will work seamlessly with the rest of the project	○	J. Klein	Database	I & II
The member(s) in the X Roll will decide which technologies will be used for each step of the project	X	S. Crimi J. Klein R. Daniel	Machine Learning Database Dashboard	I & II I & II II

Technologies Used

- Data Clean & Analysis
  - Pandas will be used to clean and perform exploratory analysis
  - Other Python dependencies like Numpy, Plotly, hvpllot, MatPlotLib will be imported as needed to assist in our data cleaning
- Database Storage
  - PostresSQ: is where we will be storing our database
- Machine Learning
  - We used PowerBI for our preliminary data inspection to assist in determining our input variables and our desired output
  - SciKitLearn library will be used to create a classifier
    - Balanced Accuracy Score
    - Confusion Matrix
    - Classification Report Imbalanced
  - Tensorflow
- Dashboard
  - The dashboard will be comprised of HTML, CSS, & JavaScript components to create an interactive dashboard allowing users to select player information from drop down fields
  - Results & visualizations will be displayed on GitHub pages and a Tableau dashboard if further storytelling is needed

Tools

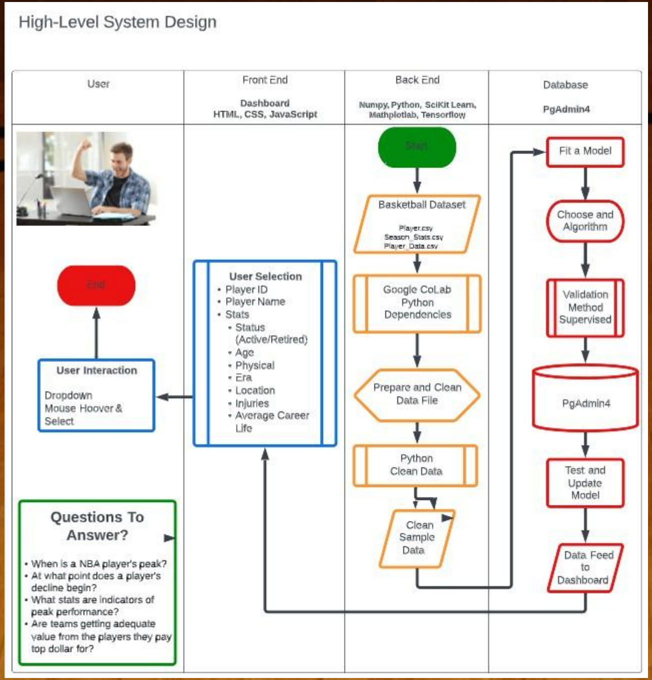
- Tools used to clean and analyze data

Systems	Tools
Data Cleaning & Analysis	Pandas Numpy MathPlotLib
ERD & FSD	Power BI Lucid Charts Quick Database Diagrams
Database	PgAdmin4 AWS
Machine Learning	SciKitLearn Jupyter Notebook Supervised Learning Model
Dashboard	HTML CSS JavaScript Tableau GitHub Pages

ERD & FSD

FSD & ERD

High-Level FSD



High-Level System Design

User

Front End

Dashboard
HTML, CSS, JavaScript

Back End

Numpy, Python, SciKit Learn, Mathplotlab, Tensorflow

Database

PgAdmin4

Start

Basketball Dataset

Player.csv
Season_Stats.csv
Player_Data.csv

Google CoLab
Python
Dependencies

Prepare and Clean
Data File

Python
Clean Data

Clean
Sample
Data

Fit a Model

Choose and
Algorithm

Validation
Method
Supervised

PgAdmin4

Test and
Update
Model

Data Feed
to
Dashboard

User Selection

- Player ID
- Player Name
- Stats
  - Status (Active/Retired)
  - Age
  - Physical
  - Era
  - Location
  - Injuries
  - Average Career Life

User Interaction

Dropdown
Mouse Hoover &
Select

End

Questions To Answer?

- When is a NBA player's peak?
- At what point does a player's decline begin?
- What stats are indicators of peak performance?
- Are teams getting adequate value from the players they pay top dollar for?

Database

Database

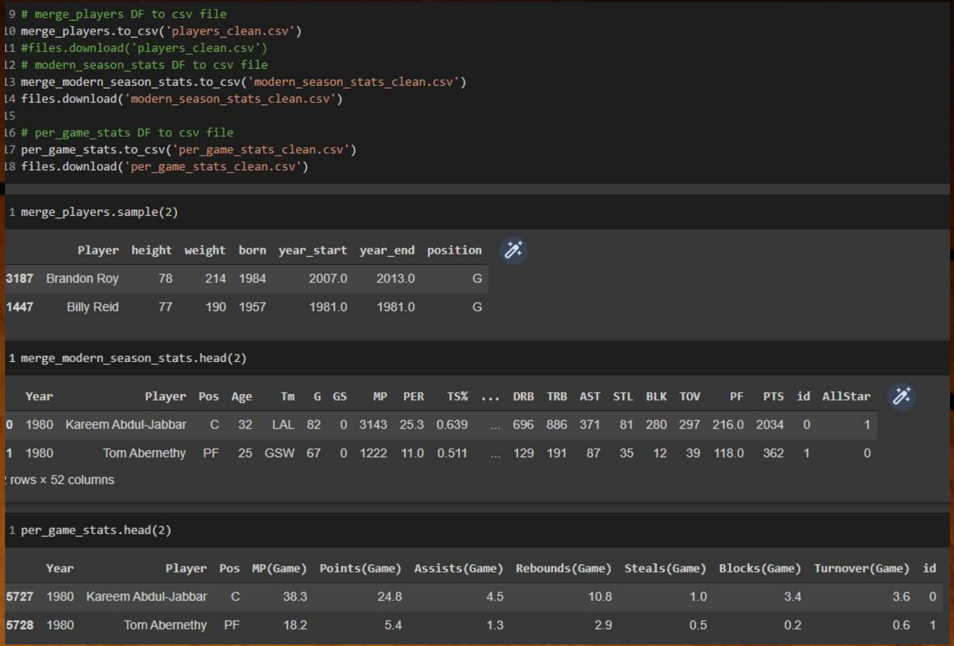
- NBA Database
  - Team members present a fully integrated database.
  - Database stroes static data for use during the project
  - Database interfaces with the project in some format(e.g., scraping updates the database, or database connects to the model)
  - Includes at least two tables (or collections, if using MongoDB)
  - Includes at least one join using the database language (not including any joins in Pandas)
  - Includes at least one connection string (using SQLAlchemy or PyMongo) Note: if you use a SQL database, you must provide your ERD with relationships.

- ETL, Postgres, Amazon AWS
  - Merge players dataframe to csv file (File downloaded players_clean.csv)
  - Modern Season Stats dataframe to csv file (File downloaded modern_season_stats_clean.csv)
  - Per game stats dataframe to csv tild (File download per_game_stats_clean.csv)

Database (cont’d)

- Perform data cleaning and output ETL documents
- Load created schema into Postgres via pgAdmin
- Upload data into PostgreSQL database
- Create AWS RDS and connect to PostgreSQL
- Connect AWS RDS to Python with SQLAlchemy

Clean data and end of ETL



```
# merge_players DF to csv file
merge_players.to_csv('players_clean.csv')
#files.download('players_clean.csv')
# modern_season_stats DF to csv file
merge_modern_season_stats.to_csv('modern_season_stats_clean.csv')
files.download('modern_season_stats_clean.csv')

# per_game_stats DF to csv file
per_game_stats.to_csv('per_game_stats_clean.csv')
files.download('per_game_stats_clean.csv')
```

```
merge_players.sample(2)
```

	Player	height	weight	born	year_start	year_end	position
3187	Brandon Roy	78	214	1984	2007.0	2013.0	G
1447	Billy Reid	77	190	1957	1981.0	1981.0	G

```
merge_modern_season_stats.head(2)
```

	Year	Player	Pos	Age	Tm	G	GS	MP	PER	TS%	...	DRB	TRB	AST	STL	BLK	TOV	PF	PTS	id	AllStar
0	1980	Kareem Abdul-Jabbar	C	32	LAL	82	0	3143	25.3	0.639	...	696	886	371	81	280	297	216.0	2034	0	1
1	1980	Tom Abernethy	PF	25	GSW	67	0	1222	11.0	0.511	...	129	191	87	35	12	39	118.0	362	1	0

rows × 52 columns

```
per_game_stats.head(2)
```

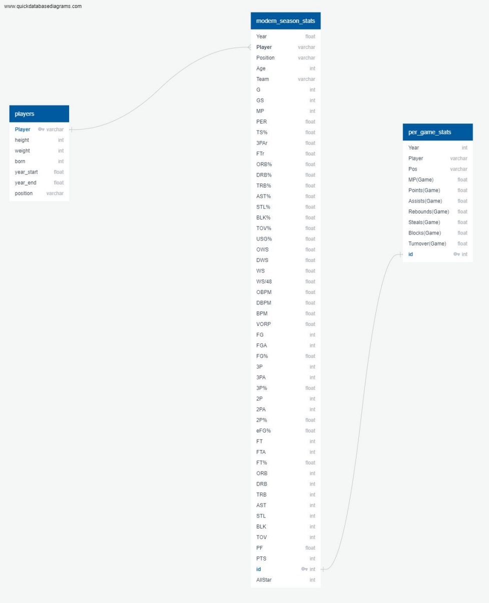
	Year	Player	Pos	MP(Game)	Points(Game)	Assists(Game)	Rebounds(Game)	Steals(Game)	Blocks(Game)	Turnover(Game)	id
5727	1980	Kareem Abdul-Jabbar	C	38.3	24.8	4.5	10.8	1.0	3.4	3.6	0
5728	1980	Tom Abernethy	PF	18.2	5.4	1.3	2.9	0.5	0.2	0.6	1

Database (cont'd)

Database ERD

- Load created schema into Postgres via pgAdmin

Sample of schema uploaded into Postgres



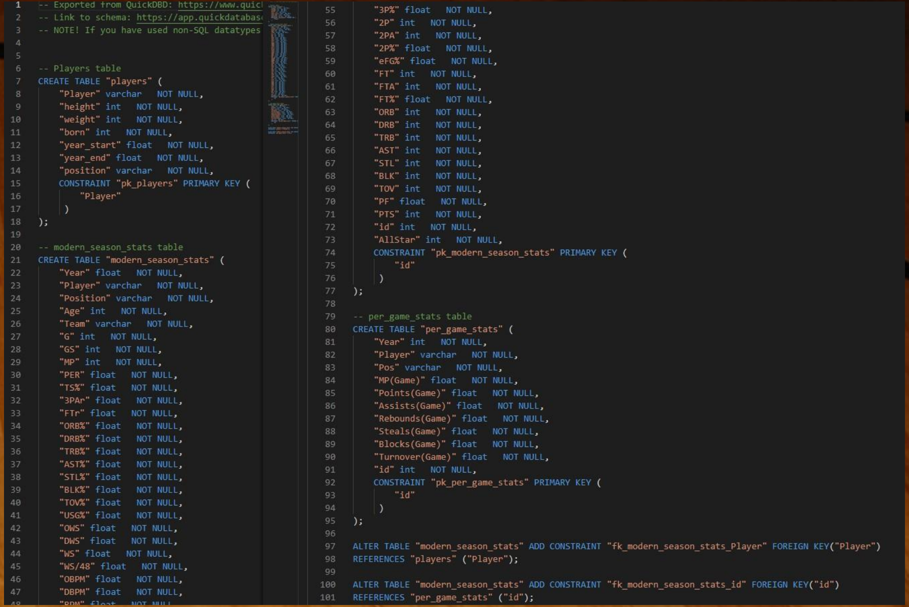
www.quickdatabasediagrams.com

players	
Player	varchar
height	int
weight	int
born	int
year_start	float
year_end	float
position	varchar

modern_season_stats	
Year	float
Player	varchar
Position	varchar
Age	int
Team	varchar
G	int
GS	int
MP	int
PER	float
TS%	float
3PAr	float
FTr	float
ORB%	float
DRB%	float
TRB%	float
AST%	float
STL%	float
BLK%	float
TOV%	float
USG%	float
OWS	float
DWS	float
WS	float
WS/48	float
OBPM	float
DBPM	float
BPM	float
VORP	float
FG	int
FGA	int
FG%	float
3P	int
3PA	int
3P%	float
2P	int
2PA	int
2P%	float
eFG%	float
FT	int
FTA	int
FT%	float
ORB	int
DRB	int
TRB	int
AST	int
STL	int
BLK	int
TOV	int
PF	float
PTS	int
id	int
AllStar	int

per_game_stats	
Year	int
Player	varchar
Pos	varchar
MP(Game)	float
Points(Game)	float
Assists(Game)	float
Rebounds(Game)	float
Steals(Game)	float
Blocks(Game)	float
Turnover(Game)	float
id	int

schema ERD



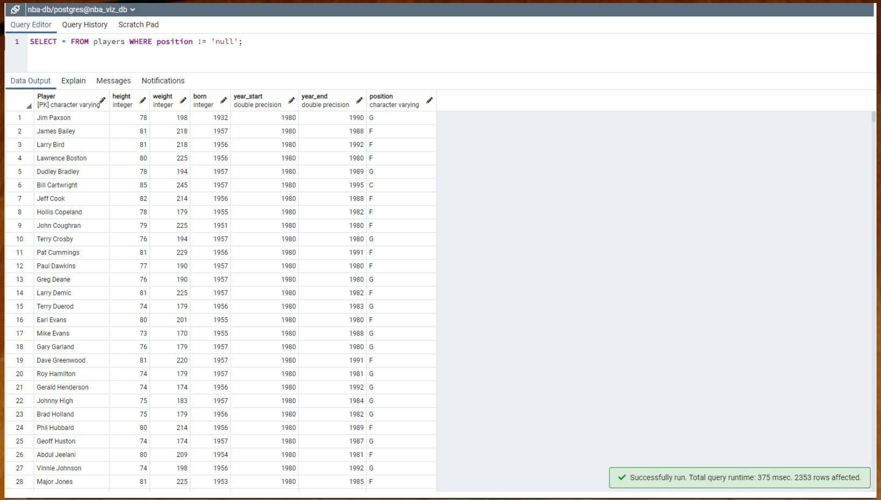
```sql
-- Exported from QuickDBD: https://www.quicl
-- Link to schema: https://app.quickdatabas
-- NOTE! If you have used non-SQL datatypes


-- Players table
CREATE TABLE "players" (
    "Player" varchar   NOT NULL,
    "height" int   NOT NULL,
    "weight" int   NOT NULL,
    "born" int   NOT NULL,
    "year_start" float   NOT NULL,
    "year_end" float   NOT NULL,
    "position" varchar   NOT NULL,
    CONSTRAINT "pk_players" PRIMARY KEY (
        "Player"
     )
);

-- modern_season_stats table
CREATE TABLE "modern_season_stats" (
    "Year" float   NOT NULL,
    "Player" varchar   NOT NULL,
    "Position" varchar   NOT NULL,
    "Age" int   NOT NULL,
    "Team" varchar   NOT NULL,
    "G" int   NOT NULL,
    "GS" int   NOT NULL,
    "MP" int   NOT NULL,
    "PER" float   NOT NULL,
    "TS%" float   NOT NULL,
    "3PAr" float   NOT NULL,
    "FTr" float   NOT NULL,
    "ORB%" float   NOT NULL,
    "DRB%" float   NOT NULL,
    "TRB%" float   NOT NULL,
    "AST%" float   NOT NULL,
    "STL%" float   NOT NULL,
    "BLK%" float   NOT NULL,
    "TOV%" float   NOT NULL,
    "USG%" float   NOT NULL,
    "OWS" float   NOT NULL,
    "DWS" float   NOT NULL,
    "WS" float   NOT NULL,
    "WS/48" float   NOT NULL,
    "OBPM" float   NOT NULL,
    "DBPM" float   NOT NULL,
    "BPM" float   NOT NULL
```

```sql
    "3P%" float   NOT NULL,
    "2P" int   NOT NULL,
    "2PA" int   NOT NULL,
    "2P%" float   NOT NULL,
    "eFG%" float   NOT NULL,
    "FT" int   NOT NULL,
    "FTA" int   NOT NULL,
    "FT%" float   NOT NULL,
    "ORB" int   NOT NULL,
    "DRB" int   NOT NULL,
    "TRB" int   NOT NULL,
    "AST" int   NOT NULL,
    "STL" int   NOT NULL,
    "BLK" int   NOT NULL,
    "TOV" int   NOT NULL,
    "PF" float   NOT NULL,
    "PTS" int   NOT NULL,
    "id" int   NOT NULL,
    "AllStar" int   NOT NULL,
    CONSTRAINT "pk_modern_season_stats" PRIMARY KEY (
        "id"
     )
);

-- per_game_stats table
CREATE TABLE "per_game_stats" (
    "Year" int   NOT NULL,
    "Player" varchar   NOT NULL,
    "Pos" varchar   NOT NULL,
    "MP(Game)" float   NOT NULL,
    "Points(Game)" float   NOT NULL,
    "Assists(Game)" float   NOT NULL,
    "Rebounds(Game)" float   NOT NULL,
    "Steals(Game)" float   NOT NULL,
    "Blocks(Game)" float   NOT NULL,
    "Turnover(Game)" float   NOT NULL,
    "id" int   NOT NULL,
    CONSTRAINT "pk_per_game_stats" PRIMARY KEY (
        "id"
     )
);

ALTER TABLE "modern_season_stats" ADD CONSTRAINT "fk_modern_season_stats_Player" FOREIGN KEY("Player")
REFERENCES "players" ("Player");

ALTER TABLE "modern_season_stats" ADD CONSTRAINT "fk_modern_season_stats_id" FOREIGN KEY("id")
REFERENCES "per_game_stats" ("id");
```

Database (cont'd)

- Upload data into PostgreSQL database

Players data SQL table

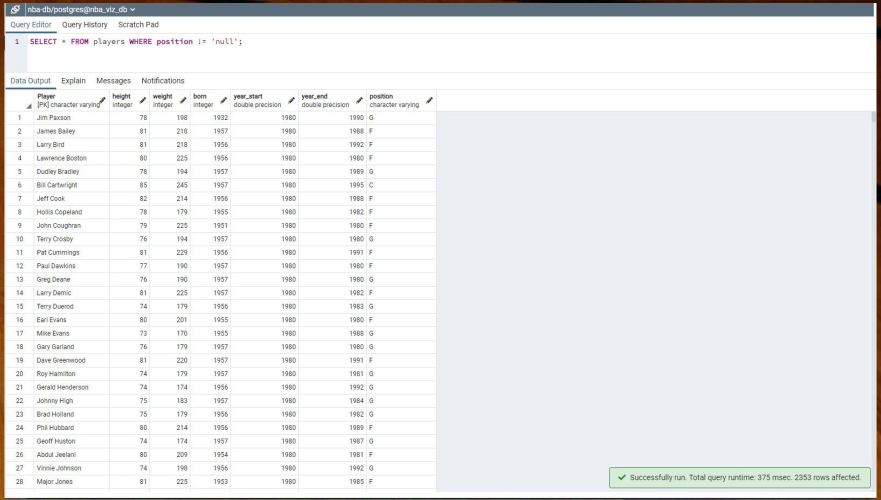


```sql
SELECT * FROM players WHERE position != 'null';
```

	Player [PK] character varying	height integer	weight integer	born integer	year_start double precision	year_end double precision	position character varying
1	Jim Paxson	78	198	1932	1980	1990	G
2	James Bailey	81	218	1957	1980	1988	F
3	Larry Bird	81	218	1956	1980	1992	F
4	Lawrence Boston	80	225	1956	1980	1980	F
5	Dudley Bradley	78	194	1957	1980	1989	G
6	Bill Cartwright	85	245	1957	1980	1995	C
7	Jeff Cook	82	214	1956	1980	1988	F
8	Hollis Copeland	78	179	1955	1980	1982	F
9	John Coughran	79	225	1951	1980	1980	F
10	Terry Crosby	76	194	1957	1980	1980	G
11	Pat Cummings	81	229	1956	1980	1991	F
12	Paul Dawkins	77	190	1957	1980	1980	F
13	Greg Deane	76	190	1957	1980	1980	G
14	Larry Demic	81	225	1957	1980	1982	F
15	Terry Duerod	74	179	1956	1980	1983	G
16	Earl Evans	80	201	1955	1980	1980	F
17	Mike Evans	73	170	1955	1980	1988	G
18	Gary Garland	76	179	1957	1980	1980	G
19	Dave Greenwood	81	220	1957	1980	1991	F
20	Roy Hamilton	74	179	1957	1980	1981	G
21	Gerald Henderson	74	174	1956	1980	1992	G
22	Johnny High	75	183	1957	1980	1984	G
23	Brad Holland	75	179	1956	1980	1982	G
24	Phil Hubbard	80	214	1956	1980	1989	F
25	Geoff Huston	74	174	1957	1980	1987	G
26	Abdul Jeelani	80	209	1954	1980	1981	F
27	Vinnie Johnson	74	198	1956	1980	1992	G
28	Major Jones	81	225	1953	1980	1985	F

✓ Successfully run. Total query runtime: 375 msec. 2353 rows affected.

Players data SQL table without null values



nba-db/postgres@nba_viz_db
Query Editor Query History Scratch Pad

SELECT * FROM players WHERE position != 'null';

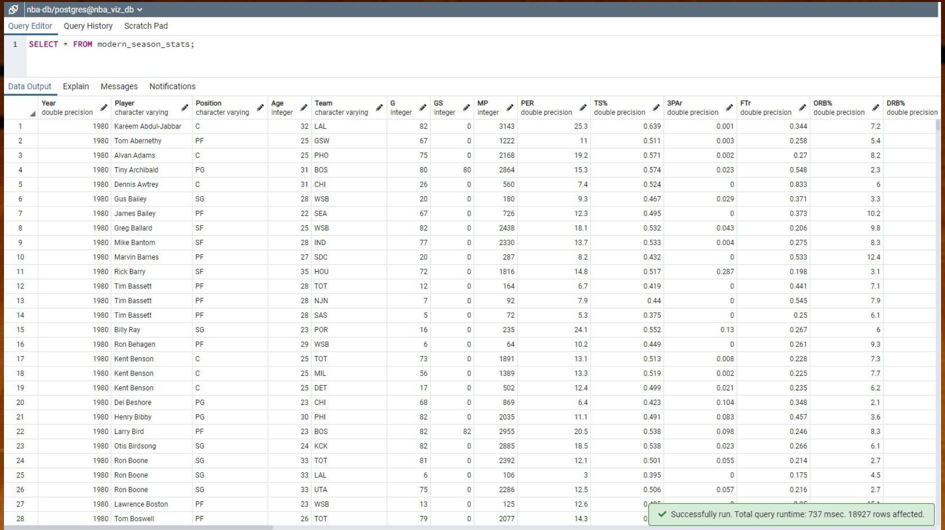
	Player [PK] character varying	height integer	weight integer	born integer	year_start double precision	year_end double precision	position character varying
1	Jim Paxson	78	198	1932	1980	1990	G
2	James Bailey	81	218	1957	1980	1988	F
3	Larry Bird	81	218	1956	1980	1992	F
4	Lawrence Boston	80	225	1956	1980	1980	F
5	Dudley Bradley	78	194	1957	1980	1989	G
6	Bill Cartwright	85	245	1957	1980	1995	C
7	Jeff Cook	82	214	1956	1980	1988	F
8	Hollis Copeland	78	179	1955	1980	1982	F
9	John Coughran	79	225	1951	1980	1980	F
10	Terry Crosby	76	194	1957	1980	1980	G
11	Pat Cummings	81	229	1956	1980	1991	F
12	Paul Dawkins	77	190	1957	1980	1980	F
13	Greg Deane	76	190	1957	1980	1980	G
14	Larry Demic	81	225	1957	1980	1982	F
15	Terry Duerod	74	179	1956	1980	1983	G
16	Earl Evans	80	201	1955	1980	1980	F
17	Mike Evans	73	170	1955	1980	1988	G
18	Gary Garland	76	179	1957	1980	1980	G
19	Dave Greenwood	81	220	1957	1980	1991	F
20	Roy Hamilton	74	179	1957	1980	1981	G
21	Gerald Henderson	74	174	1956	1980	1992	G
22	Johnny High	75	183	1957	1980	1984	G
23	Brad Holland	75	179	1956	1980	1982	G
24	Phil Hubbard	80	214	1956	1980	1989	F
25	Geoff Huston	74	174	1957	1980	1987	G
26	Abdul Jeelani	80	209	1954	1980	1981	F
27	Vinnie Johnson	74	198	1956	1980	1992	G
28	Major Jones	81	225	1953	1980	1985	F

✓ Successfully run. Total query runtime: 375 msec. 2353 rows affected.

Database (cont'd)

- Upload data into PostgreSQL database

modern season stats SQL table



nba-db/postgres@nba_viz_db

Query Editor | Query History | Scratch Pad

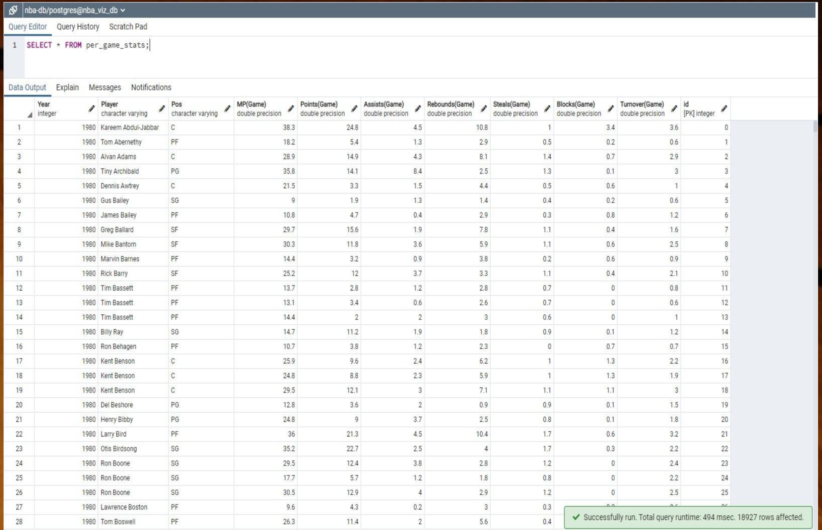
```
SELECT * FROM modern_season_stats;
```

Data Output | Explain | Messages | Notifications

	Year double precision	Player character varying	Position character varying	Age integer	Team character varying	G integer	GS integer	MP integer	PER double precision	TS% double precision	3PAr double precision	FTr double precision	ORB% double precision	DRB% double precision
1	1980	Kareem Abdul-Jabbar	C	32	LAL	82	0	3143	25.3	0.639	0.001	0.344	7.2	
2	1980	Tom Abernethy	PF	25	GSW	67	0	1222	11	0.511	0.003	0.258	5.4	
3	1980	Alvan Adams	C	25	PHO	75	0	2168	19.2	0.571	0.002	0.27	8.2	
4	1980	Tiny Archibald	PG	31	BOS	80	80	2864	15.3	0.574	0.023	0.548	2.3	
5	1980	Dennis Awtrey	C	31	CHI	26	0	560	7.4	0.524	0	0.833	6	
6	1980	Gus Bailey	SG	28	WSB	20	0	180	9.3	0.467	0.029	0.371	3.3	
7	1980	James Bailey	PF	22	SEA	67	0	726	12.3	0.495	0	0.373	10.2	
8	1980	Greg Ballard	SF	25	WSB	82	0	2438	18.1	0.532	0.043	0.206	9.8	
9	1980	Mike Bantom	SF	28	IND	77	0	2330	13.7	0.533	0.004	0.275	8.3	
10	1980	Marvin Barnes	PF	27	SDC	20	0	287	8.2	0.432	0	0.533	12.4	
11	1980	Rick Barry	SF	35	HOU	72	0	1816	14.8	0.517	0.287	0.198	3.1	
12	1980	Tim Bassett	PF	28	TOT	12	0	164	6.7	0.419	0	0.441	7.1	
13	1980	Tim Bassett	PF	28	NJN	7	0	92	7.9	0.44	0	0.545	7.9	
14	1980	Tim Bassett	PF	28	SAS	5	0	72	5.3	0.375	0	0.25	6.1	
15	1980	Billy Ray	SG	23	POR	16	0	235	24.1	0.552	0.13	0.267	6	
16	1980	Ron Behagen	PF	29	WSB	6	0	64	10.2	0.449	0	0.261	9.3	
17	1980	Kent Benson	C	25	TOT	73	0	1891	13.1	0.513	0.008	0.228	7.3	
18	1980	Kent Benson	C	25	MIL	56	0	1389	13.3	0.519	0.002	0.225	7.7	
19	1980	Kent Benson	C	25	DET	17	0	502	12.4	0.499	0.021	0.235	6.2	
20	1980	Del Beshore	PG	23	CHI	68	0	869	6.4	0.423	0.104	0.348	2.1	
21	1980	Henry Bibby	PG	30	PHI	82	0	2035	11.1	0.491	0.083	0.457	3.6	
22	1980	Larry Bird	PF	23	BOS	82	82	2955	20.5	0.538	0.098	0.246	8.3	
23	1980	Otis Birdsong	SG	24	KCK	82	0	2885	18.5	0.538	0.023	0.266	6.1	
24	1980	Ron Boone	SG	33	TOT	81	0	2392	12.1	0.501	0.055	0.214	2.7	
25	1980	Ron Boone	SG	33	LAL	6	0	106	3	0.395	0	0.175	4.5	
26	1980	Ron Boone	SG	33	UTA	75	0	2286	12.5	0.506	0.057	0.216	2.7	
27	1980	Lawrence Boston	PF	23	WSB	13	0	125	12.6	[illegible]	[illegible]	[illegible]	[illegible]	
28	1980	Tom Boswell	PF	26	TOT	79	0	2077	14.3	[illegible]	[illegible]	[illegible]	[illegible]	

✓ Successfully run. Total query runtime: 737 msec. 18927 rows affected.

per_game_stats SQL table



nba-db/postgres@nba_viz_db

Query Editor | Query History | Scratch Pad

```
SELECT * FROM per_game_stats;
```

Data Output | Explain | Messages | Notifications

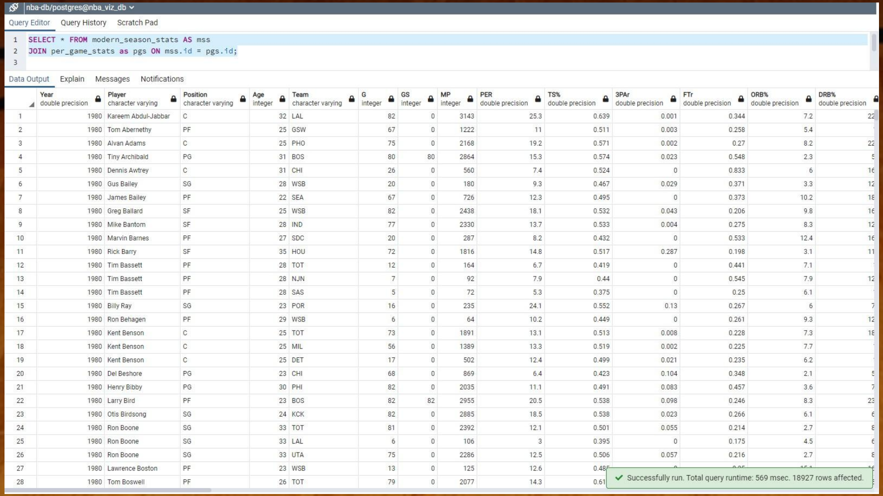
	Year integer	Player character varying	Pos character varying	MP(Game) double precision	Points(Game) double precision	Assists(Game) double precision	Rebounds(Game) double precision	Steals(Game) double precision	Blocks(Game) double precision	Turnover(Game) double precision	id [PK] integer
1	1980	Kareem Abdul-Jabbar	C	38.3	24.8	4.5	10.8	1	3.4	3.6	0
2	1980	Tom Abernethy	PF	18.2	5.4	1.3	2.9	0.5	0.2	0.6	1
3	1980	Alvan Adams	C	28.9	14.9	4.3	8.1	1.4	0.7	2.9	2
4	1980	Tiny Archibald	PG	35.8	14.1	8.4	2.5	1.3	0.1	3	3
5	1980	Dennis Awtrey	C	21.5	3.3	1.5	4.4	0.5	0.6	1	4
6	1980	Gus Bailey	SG	9	1.9	1.3	1.4	0.4	0.2	0.6	5
7	1980	James Bailey	PF	10.8	4.7	0.4	2.9	0.3	0.8	1.2	6
8	1980	Greg Ballard	SF	29.7	15.6	1.9	7.8	1.1	0.4	1.6	7
9	1980	Mike Bantom	SF	30.3	11.8	3.6	5.9	1.1	0.6	2.5	8
10	1980	Marvin Barnes	PF	14.4	3.2	0.9	3.8	0.2	0.6	0.9	9
11	1980	Rick Barry	SF	25.2	12	3.7	3.3	1.1	0.4	2.1	10
12	1980	Tim Bassett	PF	13.7	2.8	1.2	2.8	0.7	0	0.8	11
13	1980	Tim Bassett	PF	13.1	3.4	0.6	2.6	0.7	0	0.6	12
14	1980	Tim Bassett	PF	14.4	2	2	3	0.6	0	1	13
15	1980	Billy Ray	SG	14.7	11.2	1.9	1.8	0.9	0.1	1.2	14
16	1980	Ron Behagen	PF	10.7	3.8	1.2	2.3	0	0.7	0.7	15
17	1980	Kent Benson	C	25.9	9.6	2.4	6.2	1	1.3	2.2	16
18	1980	Kent Benson	C	24.8	8.8	2.3	5.9	1	1.3	1.9	17
19	1980	Kent Benson	C	29.5	12.1	3	7.1	1.1	1.1	3	18
20	1980	Del Beshore	PG	12.8	3.6	2	0.9	0.9	0.1	1.5	19
21	1980	Henry Bibby	PG	24.8	9	3.7	2.5	0.8	0.1	1.8	20
22	1980	Larry Bird	PF	36	21.3	4.5	10.4	1.7	0.6	3.2	21
23	1980	Otis Birdsong	SG	35.2	22.7	2.5	4	1.7	0.3	2.2	22
24	1980	Ron Boone	SG	29.5	12.4	3.8	2.8	1.2	0	2.4	23
25	1980	Ron Boone	SG	17.7	5.7	1.2	1.8	0.8	0	2.2	24
26	1980	Ron Boone	SG	30.5	12.9	4	2.9	1.2	0	2.5	25
27	1980	Lawrence Boston	PF	9.6	4.3	0.2	3	0.3	[illegible]	[illegible]	[illegible]
28	1980	Tom Boswell	PF	26.3	11.4	2	5.6	0.4	[illegible]	[illegible]	[illegible]

✓ Successfully run. Total query runtime: 494 msec. 18927 rows affected.

Database (cont'd)

- PostgreSQL database tables with joins

Joining modern season stats and per_game_stats SQL table

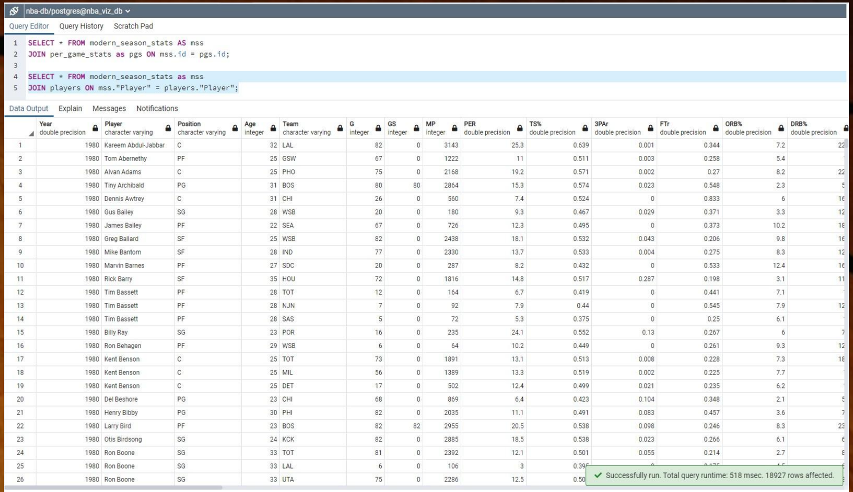


```
SELECT * FROM modern_season_stats AS mss
JOIN per_game_stats as pgs ON mss.id = pgs.id;

```

	Year double precision	Player character varying	Position character varying	Age integer	Team character varying	G integer	GS integer	MP integer	PER double precision	TS% double precision	3PAr double precision	FTr double precision	ORB% double precision	DRB% double precision
1	1980	Kareem Abdul-Jabbar	C	32	LAL	82	0	3143	25.3	0.639	0.001	0.344	7.2	22
2	1980	Tom Abernethy	PF	25	GSW	67	0	1222	11	0.511	0.003	0.258	5.4	
3	1980	Alvan Adams	C	25	PHO	75	0	2168	19.2	0.571	0.002	0.27	8.2	22
4	1980	Tiny Archibald	PG	31	BOS	80	80	2864	15.3	0.574	0.023	0.548	2.3	5
5	1980	Dennis Awtrey	C	31	CHI	26	0	560	7.4	0.524	0	0.833	6	16
6	1980	Gus Bailey	SG	28	WSB	20	0	180	9.3	0.467	0.029	0.371	3.3	12
7	1980	James Bailey	PF	22	SEA	67	0	726	12.3	0.495	0	0.373	10.2	18
8	1980	Greg Ballard	SF	25	WSB	82	0	2438	18.1	0.532	0.043	0.206	9.8	16
9	1980	Mike Bantom	SF	28	IND	77	0	2330	13.7	0.533	0.004	0.275	8.3	12
10	1980	Marvin Barnes	PF	27	SDC	20	0	287	8.2	0.432	0	0.533	12.4	16
11	1980	Rick Barry	SF	35	HOU	72	0	1816	14.8	0.517	0.287	0.198	3.1	11
12	1980	Tim Bassett	PF	28	TOT	12	0	164	6.7	0.419	0	0.441	7.1	
13	1980	Tim Bassett	PF	28	NJN	7	0	92	7.9	0.44	0	0.545	7.9	12
14	1980	Tim Bassett	PF	28	SAS	5	0	72	5.3	0.375	0	0.25	6.1	
15	1980	Billy Ray	SG	23	POR	16	0	235	24.1	0.552	0.13	0.267	6	7
16	1980	Ron Behagen	PF	29	WSB	6	0	64	10.2	0.449	0	0.261	9.3	12
17	1980	Kent Benson	C	25	TOT	73	0	1891	13.1	0.513	0.008	0.228	7.3	18
18	1980	Kent Benson	C	25	MIL	56	0	1389	13.3	0.519	0.002	0.225	7.7	
19	1980	Kent Benson	C	25	DET	17	0	502	12.4	0.499	0.021	0.235	6.2	
20	1980	Del Beshore	PG	23	CHI	68	0	869	6.4	0.423	0.104	0.348	2.1	5
21	1980	Henry Bibby	PG	30	PHI	82	0	2035	11.1	0.491	0.083	0.457	3.6	7
22	1980	Larry Bird	PF	23	BOS	82	82	2955	20.5	0.538	0.098	0.246	8.3	23
23	1980	Otis Birdsong	SG	24	KCK	82	0	2885	18.5	0.538	0.023	0.266	6.1	6
24	1980	Ron Boone	SG	33	TOT	81	0	2392	12.1	0.501	0.055	0.214	2.7	8
25	1980	Ron Boone	SG	33	LAL	6	0	106	3	0.395	0	0.175	4.5	6
26	1980	Ron Boone	SG	33	UTA	75	0	2286	12.5	0.506	0.057	0.216	2.7	8
27	1980	Lawrence Boston	PF	23	WSB	13	0	125	12.6	0.48				16
28	1980	Tom Boswell	PF	26	TOT	79	0	2077	14.3	0.61				

✓ Successfully run. Total query runtime: 569 msec. 18927 rows affected.

Joining modern_season_stats and players SQL table



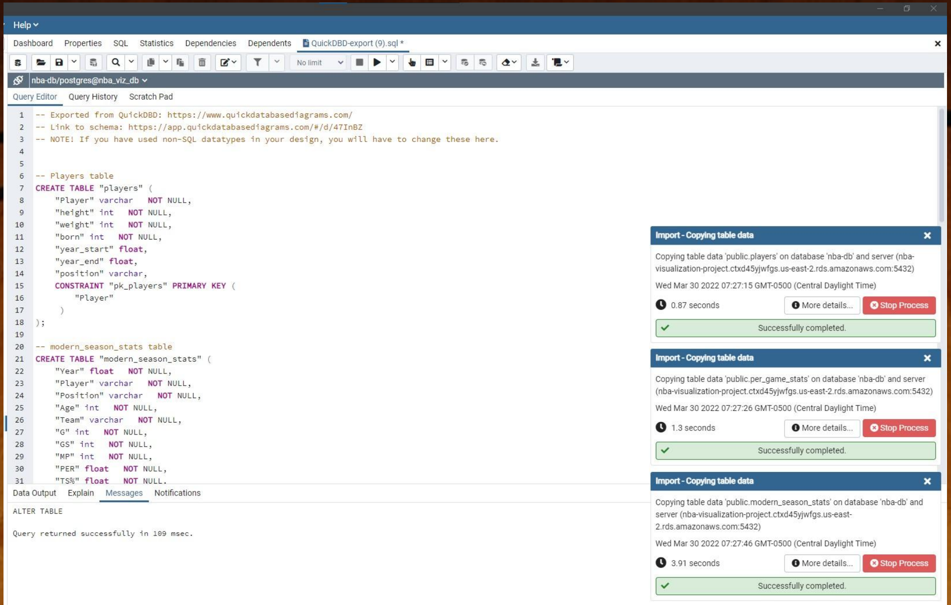
```
SELECT * FROM modern_season_stats AS mss
JOIN per_game_stats as pgs ON mss.id = pgs.id;

SELECT * FROM modern_season_stats as mss
JOIN players ON mss."Player" = players."Player";
```

	Year double precision	Player character varying	Position character varying	Age integer	Team character varying	G integer	GS integer	MP integer	PER double precision	TS% double precision	3PAr double precision	FTr double precision	ORB% double precision	DRB% double precision
1	1980	Kareem Abdul-Jabbar	C	32	LAL	82	0	3143	25.3	0.639	0.001	0.344	7.2	22
2	1980	Tom Abernethy	PF	25	GSW	67	0	1222	11	0.511	0.003	0.258	5.4	
3	1980	Alvan Adams	C	25	PHO	75	0	2168	19.2	0.571	0.002	0.27	8.2	22
4	1980	Tiny Archibald	PG	31	BOS	80	80	2864	15.3	0.574	0.023	0.548	2.3	5
5	1980	Dennis Awtrey	C	31	CHI	26	0	560	7.4	0.524	0	0.833	6	16
6	1980	Gus Bailey	SG	28	WSB	20	0	180	9.3	0.467	0.029	0.371	3.3	12
7	1980	James Bailey	PF	22	SEA	67	0	726	12.3	0.495	0	0.373	10.2	18
8	1980	Greg Ballard	SF	25	WSB	82	0	2438	18.1	0.532	0.043	0.206	9.8	16
9	1980	Mike Bantom	SF	28	IND	77	0	2330	13.7	0.533	0.004	0.275	8.3	12
10	1980	Marvin Barnes	PF	27	SDC	20	0	287	8.2	0.432	0	0.533	12.4	16
11	1980	Rick Barry	SF	35	HOU	72	0	1816	14.8	0.517	0.287	0.198	3.1	11
12	1980	Tim Bassett	PF	28	TOT	12	0	164	6.7	0.419	0	0.441	7.1	
13	1980	Tim Bassett	PF	28	NJN	7	0	92	7.9	0.44	0	0.545	7.9	12
14	1980	Tim Bassett	PF	28	SAS	5	0	72	5.3	0.375	0	0.25	6.1	
15	1980	Billy Ray	SG	23	POR	16	0	235	24.1	0.552	0.13	0.267	6	7
16	1980	Ron Behagen	PF	29	WSB	6	0	64	10.2	0.449	0	0.261	9.3	12
17	1980	Kent Benson	C	25	TOT	73	0	1891	13.1	0.513	0.008	0.228	7.3	18
18	1980	Kent Benson	C	25	MIL	56	0	1389	13.3	0.519	0.002	0.225	7.7	
19	1980	Kent Benson	C	25	DET	17	0	502	12.4	0.499	0.021	0.235	6.2	
20	1980	Del Beshore	PG	23	CHI	68	0	869	6.4	0.423	0.104	0.348	2.1	5
21	1980	Henry Bibby	PG	30	PHI	82	0	2035	11.1	0.491	0.083	0.457	3.6	7
22	1980	Larry Bird	PF	23	BOS	82	82	2955	20.5	0.538	0.098	0.246	8.3	23
23	1980	Otis Birdsong	SG	24	KCK	82	0	2885	18.5	0.538	0.023	0.266	6.1	6
24	1980	Ron Boone	SG	33	TOT	81	0	2392	12.1	0.501	0.055	0.214	2.7	8
25	1980	Ron Boone	SG	33	LAL	6	0	106	3	0.39				
26	1980	Ron Boone	SG	33	UTA	75	0	2286	12.5	0.50				

✓ Successfully run. Total query runtime: 518 msec. 18927 rows affected.

Database (cont’d)

- Create AWS RDS and connect to PostgreSQL



```sql
-- Exported from QuickDBD: https://www.quickdatabasediagrams.com/
-- Link to schema: https://app.quickdatabasediagrams.com/#/d/47InBZ
-- NOTE! If you have used non-SQL datatypes in your design, you will have to change these here.


-- Players table
CREATE TABLE "players" (
    "Player" varchar   NOT NULL,
    "height" int   NOT NULL,
    "weight" int   NOT NULL,
    "born" int   NOT NULL,
    "year_start" float,
    "year_end" float,
    "position" varchar,
    CONSTRAINT "pk_players" PRIMARY KEY (
        "Player"
     )
);

-- modern_season_stats table
CREATE TABLE "modern_season_stats" (
    "Year" float   NOT NULL,
    "Player" varchar   NOT NULL,
    "Position" varchar   NOT NULL,
    "Age" int   NOT NULL,
    "Team" varchar   NOT NULL,
    "G" int   NOT NULL,
    "GS" int   NOT NULL,
    "MP" int   NOT NULL,
    "PER" float   NOT NULL,
    "TS%" float   NOT NULL,
```

```
ALTER TABLE

Query returned successfully in 109 msec.
```

Import - Copying table data

Copying table data 'public.players' on database 'nba-db' and server (nba-visualization-project.ctxd45yjwfgs.us-east-2.rds.amazonaws.com:5432)

Wed Mar 30 2022 07:27:15 GMT-0500 (Central Daylight Time)

0.87 seconds

Successfully completed.

Import - Copying table data

Copying table data 'public.per_game_stats' on database 'nba-db' and server (nba-visualization-project.ctxd45yjwfgs.us-east-2.rds.amazonaws.com:5432)

Wed Mar 30 2022 07:27:26 GMT-0500 (Central Daylight Time)

1.3 seconds

Successfully completed.

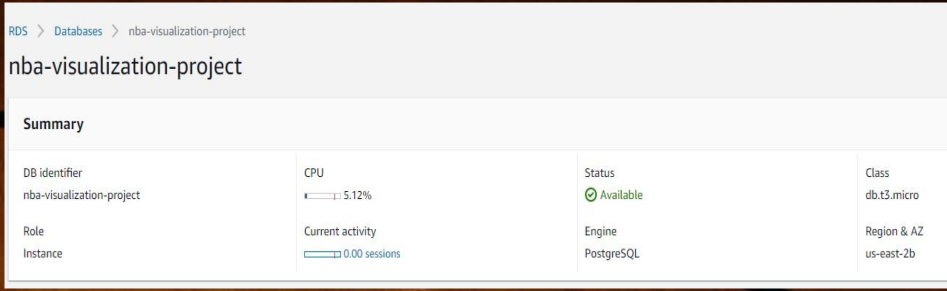
Import - Copying table data

Copying table data 'public.modern_season_stats' on database 'nba-db' and server (nba-visualization-project.ctxd45yjwfgs.us-east-2.rds.amazonaws.com:5432)

Wed Mar 30 2022 07:27:46 GMT-0500 (Central Daylight Time)

3.91 seconds

Successfully completed.



nba-visualization-project

Summary

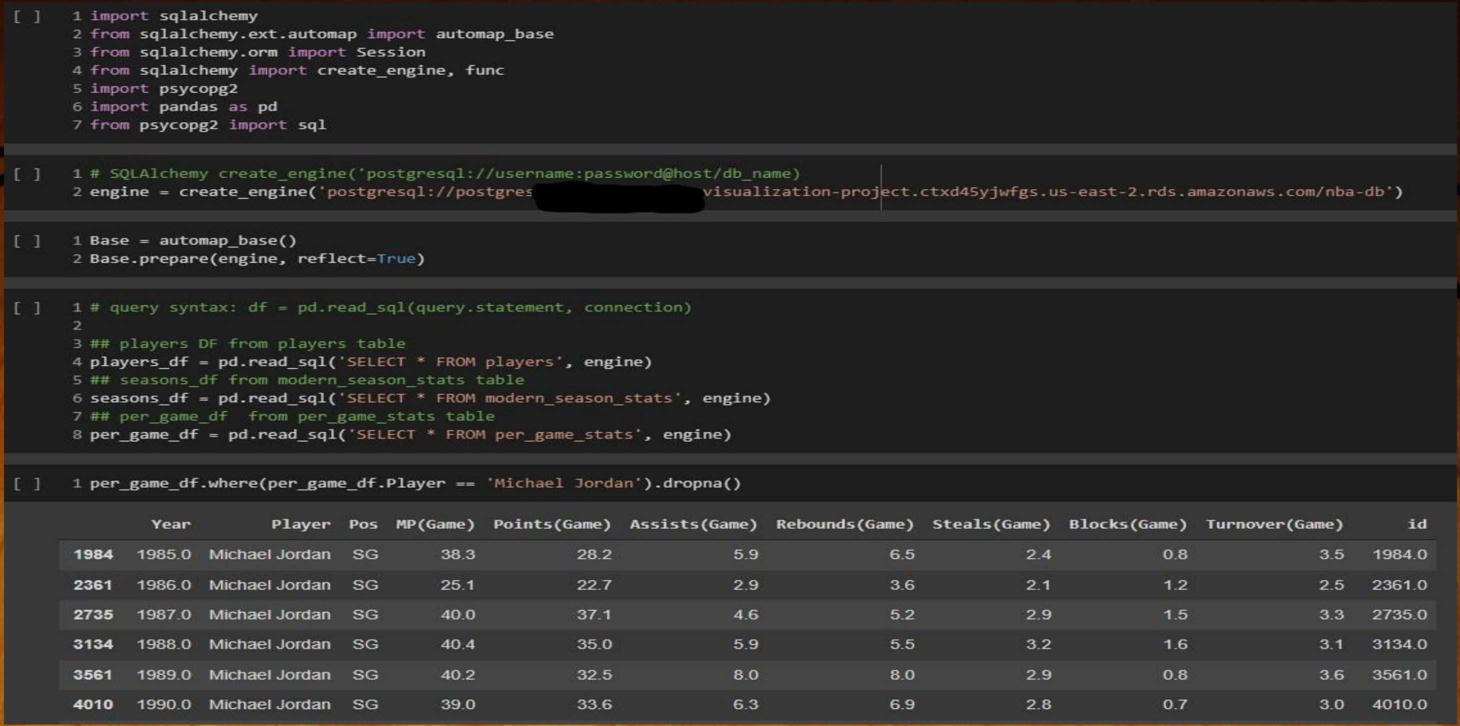
DB identifier	CPU	Status	Class
nba-visualization-project	5.12%	✓ Available	db.t3.micro
Role	Current activity	Engine	Region & AZ
Instance	0.00 sessions	PostgreSQL	us-east-2b

Database created in AWS

PostgreSQL database connected to AWS

Database (cont’d)

- Connect AWS RDS to Python with SQLAlchemy



```
import sqlalchemy
from sqlalchemy.ext.automap import automap_base
from sqlalchemy.orm import Session
from sqlalchemy import create_engine, func
import psycopg2
import pandas as pd
from psycopg2 import sql
```

```
# SQLAlchemy create_engine('postgresql://username:password@host/db_name)
engine = create_engine('postgresql://postgres[redacted]visualization-project.ctxd45yjwfgs.us-east-2.rds.amazonaws.com/nba-db')
```

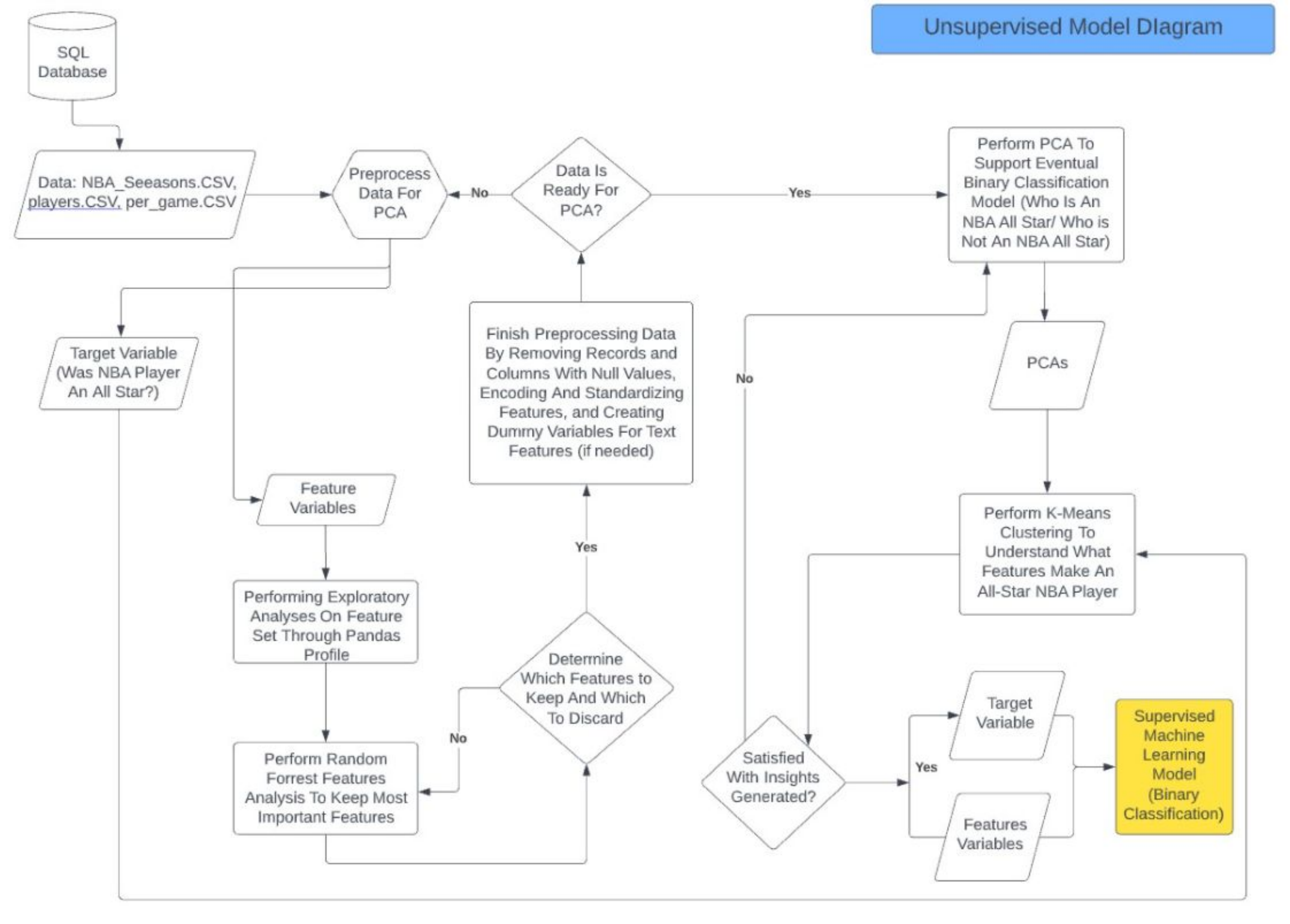
```
Base = automap_base()
Base.prepare(engine, reflect=True)
```

```
# query syntax: df = pd.read_sql(query.statement, connection)

## players DF from players table
players_df = pd.read_sql('SELECT * FROM players', engine)
## seasons_df from modern_season_stats table
seasons_df = pd.read_sql('SELECT * FROM modern_season_stats', engine)
## per_game_df  from per_game_stats table
per_game_df = pd.read_sql('SELECT * FROM per_game_stats', engine)
```

```
per_game_df.where(per_game_df.Player == 'Michael Jordan').dropna()
```

	Year	Player	Pos	MP(Game)	Points(Game)	Assists(Game)	Rebounds(Game)	Steals(Game)	Blocks(Game)	Turnover(Game)	id
1984	1985.0	Michael Jordan	SG	38.3	28.2	5.9	6.5	2.4	0.8	3.5	1984.0
2361	1986.0	Michael Jordan	SG	25.1	22.7	2.9	3.6	2.1	1.2	2.5	2361.0
2735	1987.0	Michael Jordan	SG	40.0	37.1	4.6	5.2	2.9	1.5	3.3	2735.0
3134	1988.0	Michael Jordan	SG	40.4	35.0	5.9	5.5	3.2	1.6	3.1	3134.0
3561	1989.0	Michael Jordan	SG	40.2	32.5	8.0	8.0	2.9	0.8	3.6	3561.0
4010	1990.0	Michael Jordan	SG	39.0	33.6	6.3	6.9	2.8	0.7	3.0	4010.0

Machine Learning



Unsupervised Model Diagram

SQL Database

Data: NBA_Seeasons.CSV, players.CSV, per_game.CSV

Preprocess Data For PCA

No

Data Is Ready For PCA?

Yes

Perform PCA To Support Eventual Binary Classification Model (Who Is An NBA All Star/ Who is Not An NBA All Star)

Target Variable (Was NBA Player An All Star?)

Finish Preprocessing Data By Removing Records and Columns With Null Values, Encoding And Standardizing Features, and Creating Dummy Variables For Text Features (if needed)

No

PCAs

Feature Variables

Yes

Perform K-Means Clustering To Understand What Features Make An All-Star NBA Player

Performing Exploratory Analyses On Feature Set Through Pandas Profile

Determine Which Features to Keep And Which To Discard

No

Perform Random Forrest Features Analysis To Keep Most Important Features

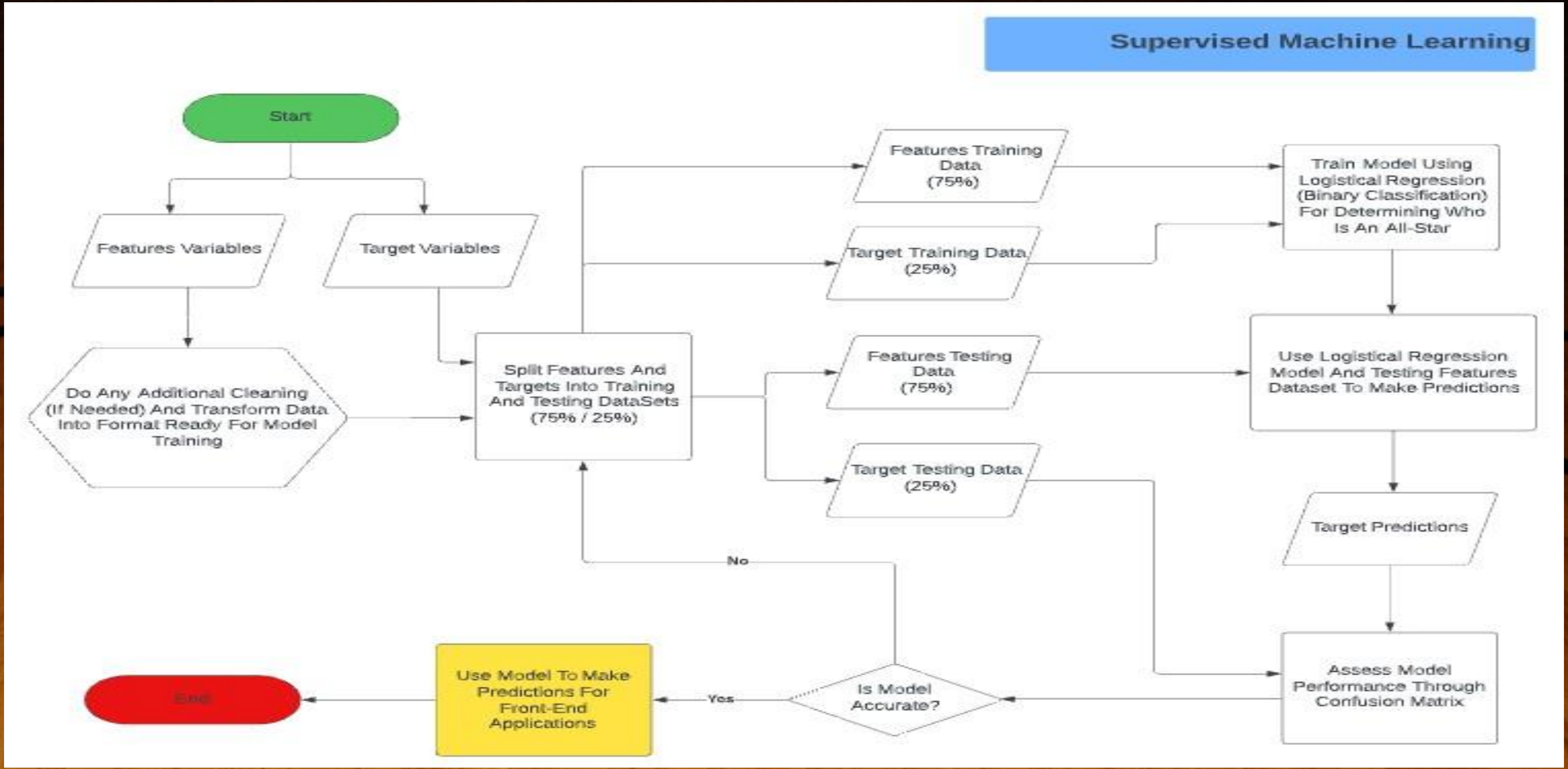
Satisfied With Insights Generated?

Yes

Target Variable

Features Variables

Supervised Machine Learning Model (Binary Classification)



Supervised Machine Learning

Start

Features Variables

Target Variables

Do Any Additional Cleaning (If Needed) And Transform Data Into Format Ready For Model Training

Split Features And Targets Into Training And Testing DataSets (75% / 25%)

Features Training Data (75%)

Target Training Data (25%)

Features Testing Data (75%)

Target Testing Data (25%)

Train Model Using Logistical Regression (Binary Classification) For Determining Who Is An All-Star

Use Logistical Regression Model And Testing Features Dataset To Make Predictions

Target Predictions

Assess Model Performance Through Confusion Matrix

Is Model Accurate?

No

Yes

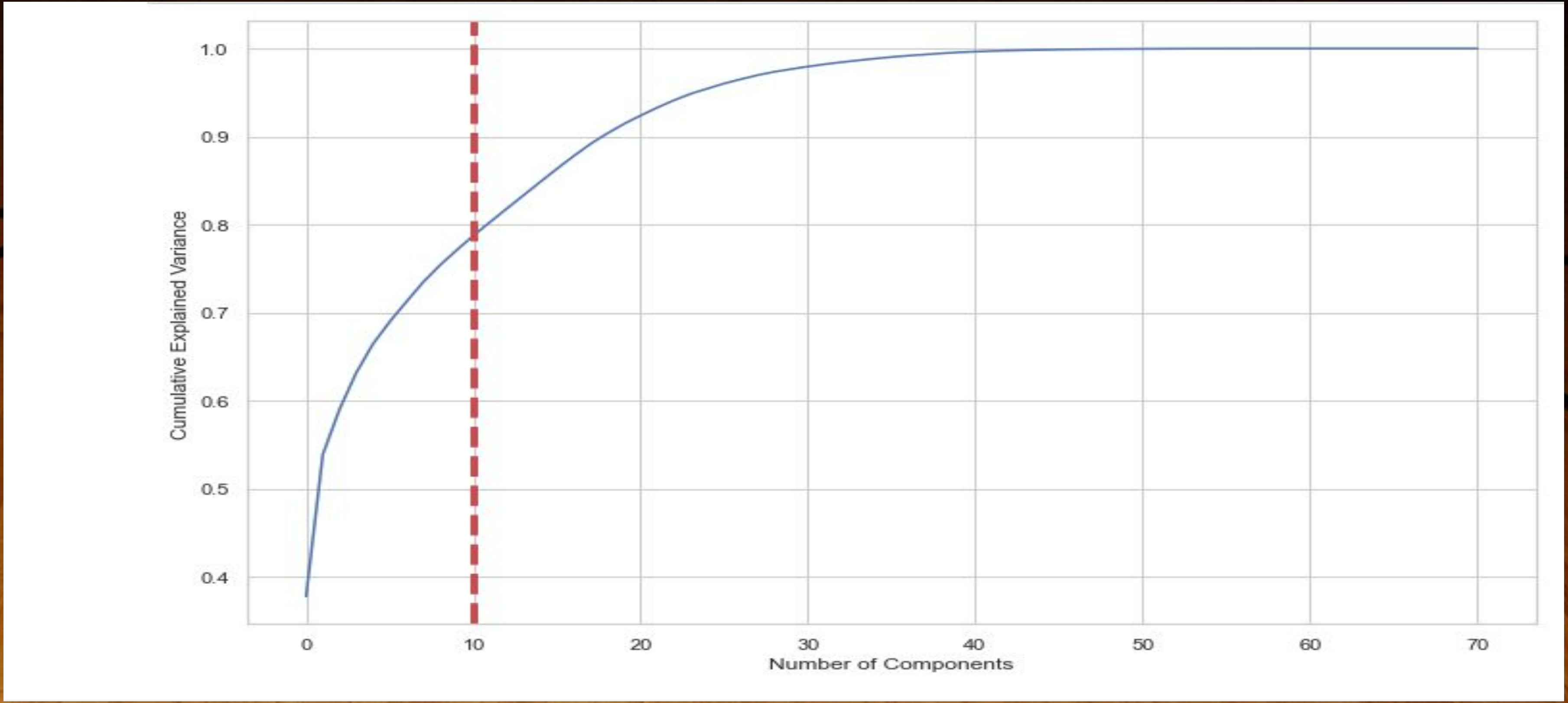
Use Model To Make Predictions For Front-End Applications

End

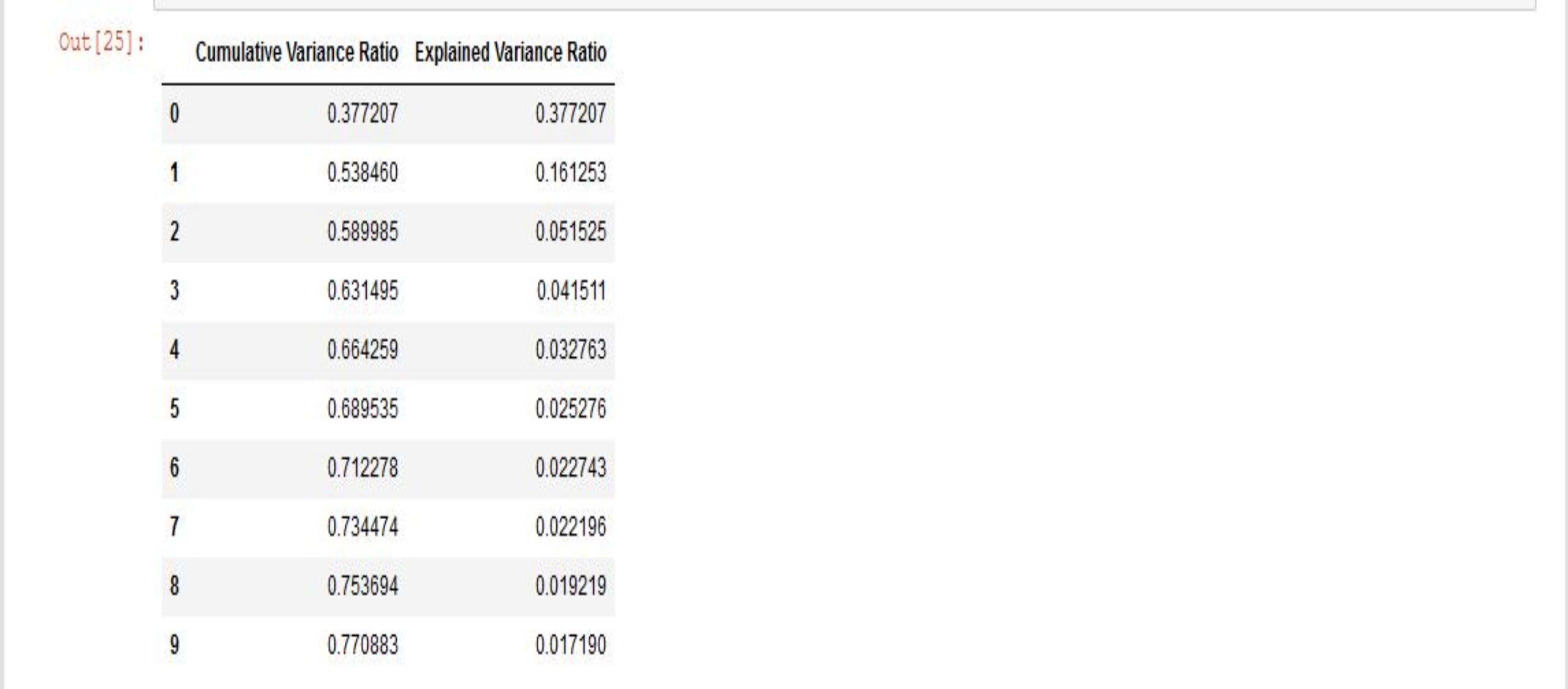
Pre-Processing

- Initially ranked by feature importance through random forests without PCA.
- Saw overrepresentation issues with non-NBA players so performed over- and under-sampling.
- Decided to go with under-sampling and applied it as a pre-processing step for ALL OF OUR MODELS.
- Performed other cleaning tasks for the features.
- Target was whether player would be an NBA AllStar (1) or not (0).

PCA: Going From 68 to 10!



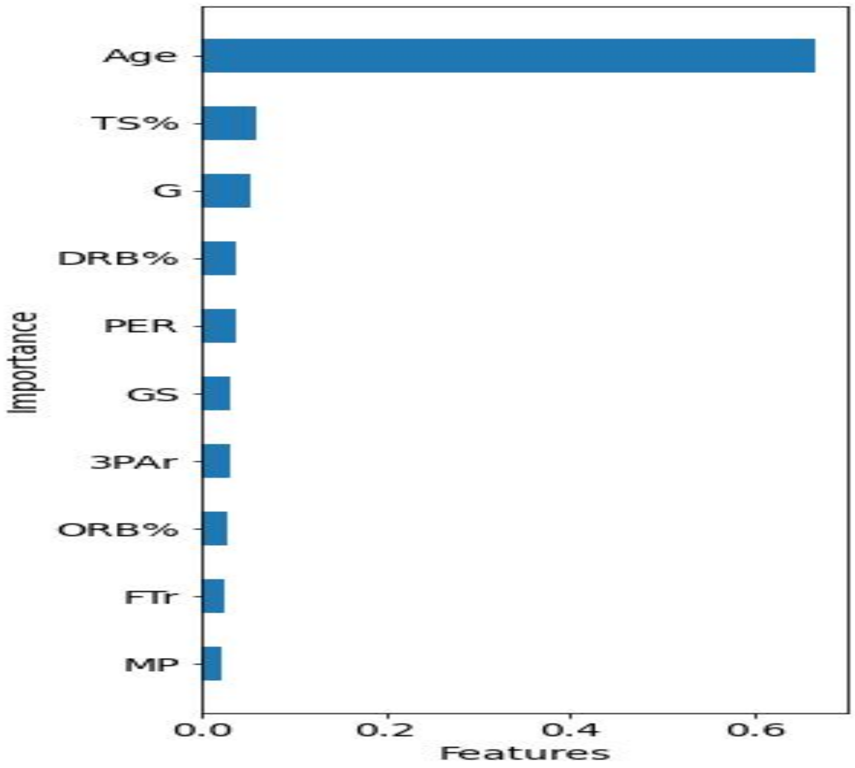
PCA: Top Ten Features Explanatory Power



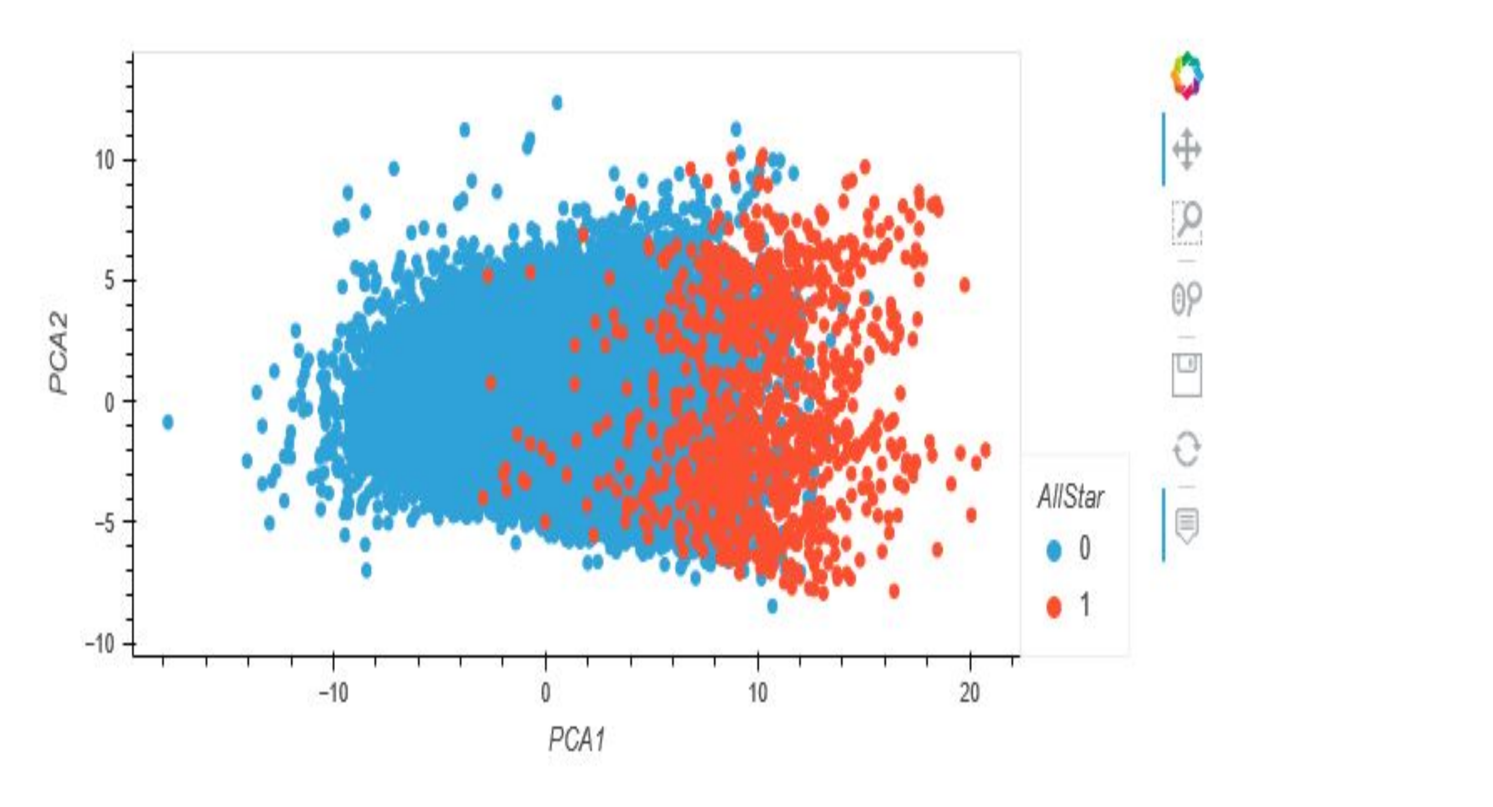
Out[25]:

	Cumulative Variance Ratio	Explained Variance Ratio
0	0.377207	0.377207
1	0.538460	0.161253
2	0.589985	0.051525
3	0.631495	0.041511
4	0.664259	0.032763
5	0.689535	0.025276
6	0.712278	0.022743
7	0.734474	0.022196
8	0.753694	0.019219
9	0.770883	0.017190

PCA: Top Ten Features



K-Means

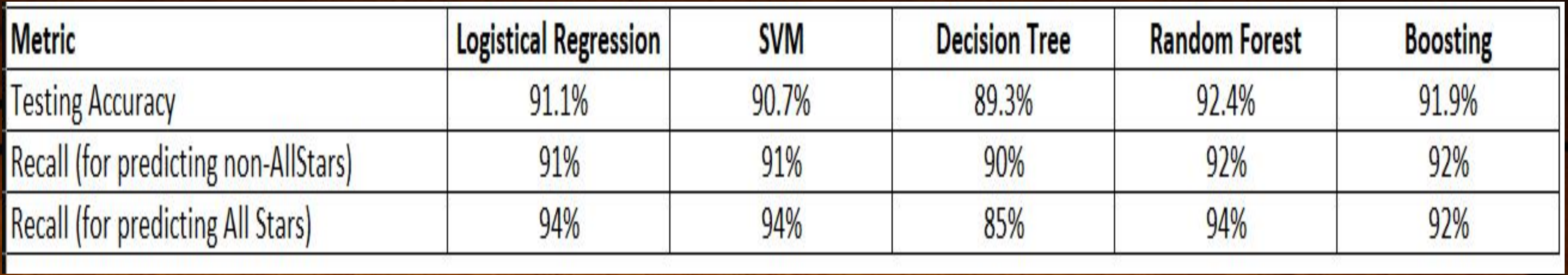


Supervised Models

- Metrics of Interests: Accuracy and Recall.
- Binary Classification!!!
- Models:

a.) Logistic Regression
b.) Support Vector Machine
c.) Decision Tree
d.) Random Forests (with top ten variables this time!)
e.) Boosting

Summary of Supervised Performances!



Metric	Logistical Regression	SVM	Decision Tree	Random Forest	Boosting
Testing Accuracy	91.1%	90.7%	89.3%	92.4%	91.9%
Recall (for predicting non-AllStars)	91%	91%	90%	92%	92%
Recall (for predicting All Stars)	94%	94%	85%	94%	92%

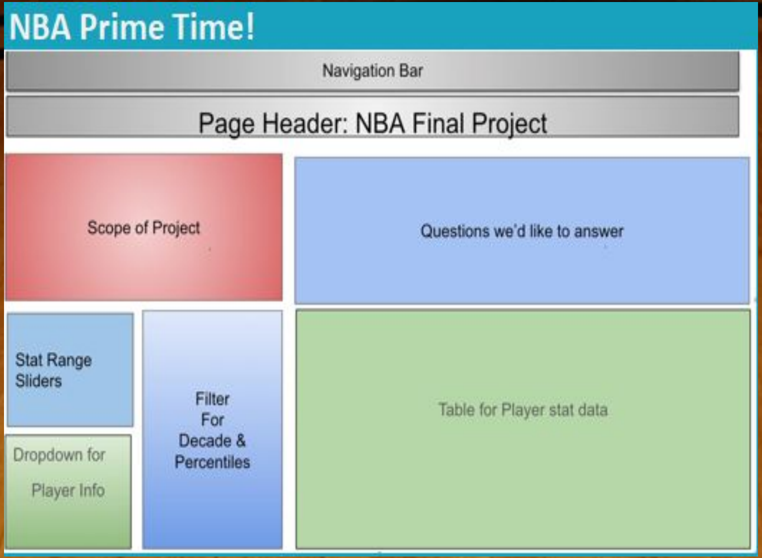
Dashboard Storyboards & Mockups

Storyboards & Dashboard

- A blueprint for the dashboard is created and includes all of the following:
  - Storyboard on Google Slide(s)
  - Description of tool(s) that will be used to create final dashboard
  - Description of interactive element(s)
- Tools used :
  - HTML
  - .css
  - JavaScript
  - Tableau
  - GitHub Pages

Dashboard - Page 1

Storyboard Layout



NBA Prime Time!

Navigation Bar

Page Header: NBA Final Project

Scope of Project

Questions we'd like to answer

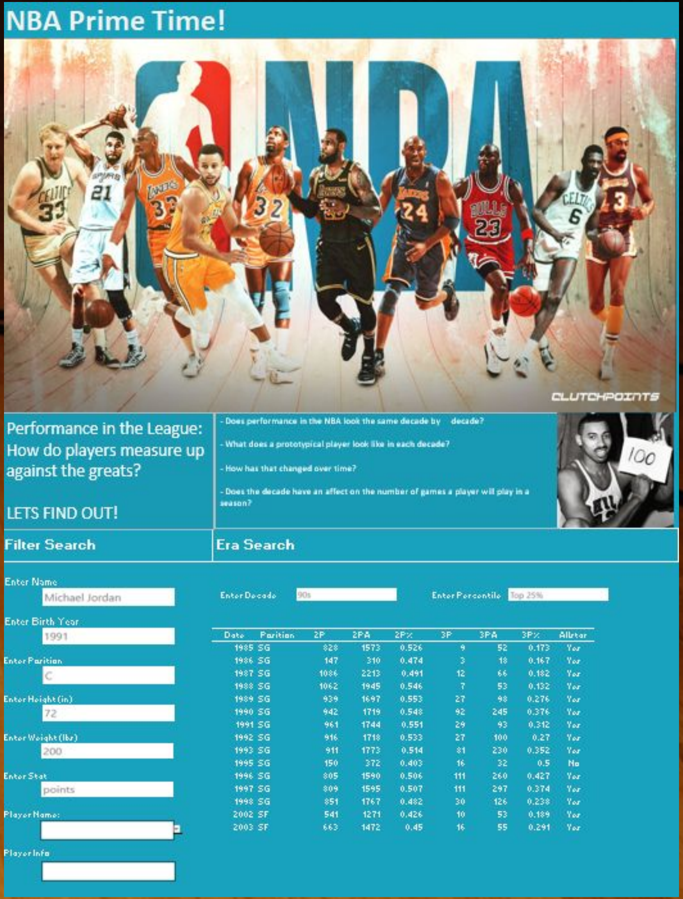
Stat Range Sliders

Dropdown for Player Info

Filter For Decade & Percentiles

Table for Player stat data

Mockup Page



NBA Prime Time!

Performance in the League: How do players measure up against the greats?

LETS FIND OUT!

- Does performance in the NBA look the same decade by decade?

- What does a prototypical player look like in each decade?

- How has that changed over time?

- Does the decade have an affect on the number of games a player will play in a season?

Filter Search

Enter Name: Michael Jordan

Enter Birth Year: 1991

Enter Position: C

Enter Height (in): 72

Enter Weight (lbs): 200

Enter Stat: points

Player Name:

Player Info

Era Search

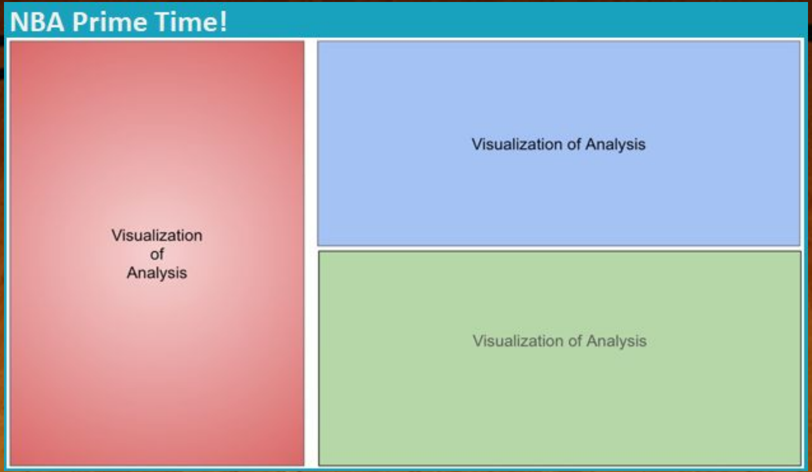
Enter Decade: 90s

Enter Percentile: Top 25%

Date	Position	2P	2PA	2P%	3P	3PA	3P%	Allstar
1985	SG	828	1573	0.526	9	52	0.173	Yes
1986	SG	147	310	0.474	3	18	0.167	Yes
1987	SG	1086	2213	0.491	12	66	0.182	Yes
1988	SG	1062	1945	0.546	7	53	0.132	Yes
1989	SG	939	1697	0.553	27	98	0.276	Yes
1990	SG	942	1719	0.548	92	245	0.376	Yes
1991	SG	961	1744	0.551	29	93	0.312	Yes
1992	SG	916	1718	0.533	27	100	0.27	Yes
1993	SG	911	1773	0.514	81	230	0.352	Yes
1995	SG	150	372	0.403	16	32	0.5	No
1996	SG	805	1590	0.506	111	260	0.427	Yes
1997	SG	809	1595	0.507	111	297	0.374	Yes
1998	SG	851	1767	0.482	30	126	0.238	Yes
2002	SF	541	1271	0.426	10	53	0.189	Yes
2003	SF	663	1472	0.45	16	55	0.291	Yes

Dashboard - Page 2

Storyboard Layout



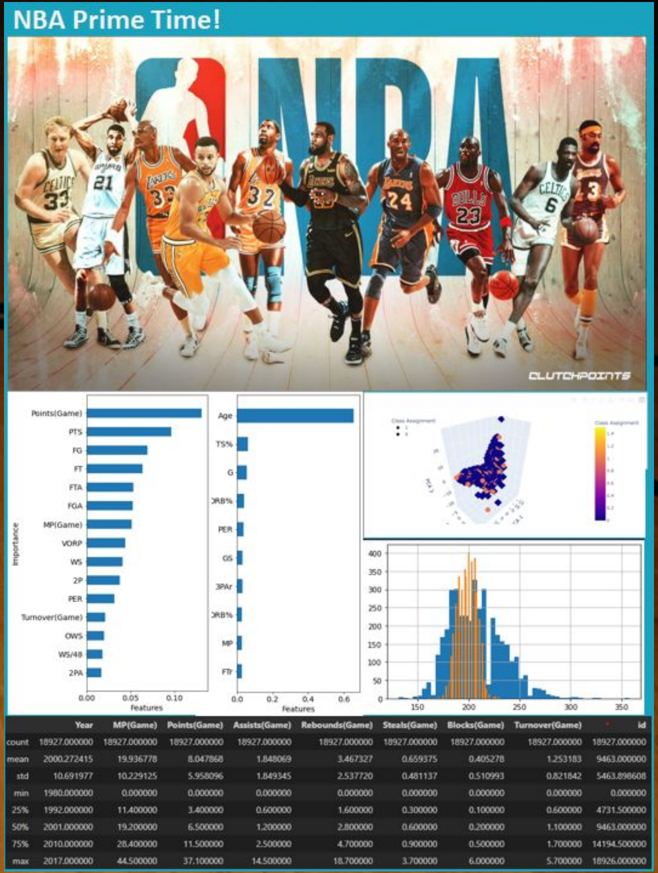
NBA Prime Time!

Visualization of Analysis

Visualization of Analysis

Visualization of Analysis

Mockup Page

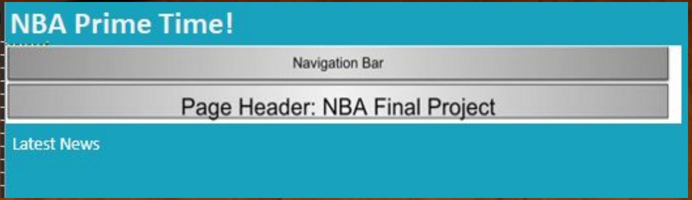


NBA Prime Time!

	Year	MP(Game)	Points(Game)	Assists(Game)	Rebounds(Game)	Steals(Game)	Blocks(Game)	Turnover(Game)	id
count	18927.000000	18927.000000	18927.000000	18927.000000	18927.000000	18927.000000	18927.000000	18927.000000	18927.000000
mean	2000.272415	19.936778	8.047868	1.848069	3.467327	0.659375	0.405278	1.253183	9463.000000
std	10.691977	10.229125	5.958096	1.849345	2.537720	0.481137	0.510993	0.821842	5463.898608
min	1980.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
25%	1992.000000	11.400000	3.400000	0.600000	1.600000	0.300000	0.100000	0.600000	4731.500000
50%	2001.000000	19.200000	6.500000	1.200000	2.800000	0.600000	0.200000	1.100000	9463.000000
75%	2010.000000	28.400000	11.500000	2.500000	4.700000	0.900000	0.500000	1.700000	14194.500000
max	2017.000000	44.500000	37.100000	14.500000	18.700000	3.700000	6.000000	5.700000	18926.000000

Dashboard - Page 3

Storyboard Layout



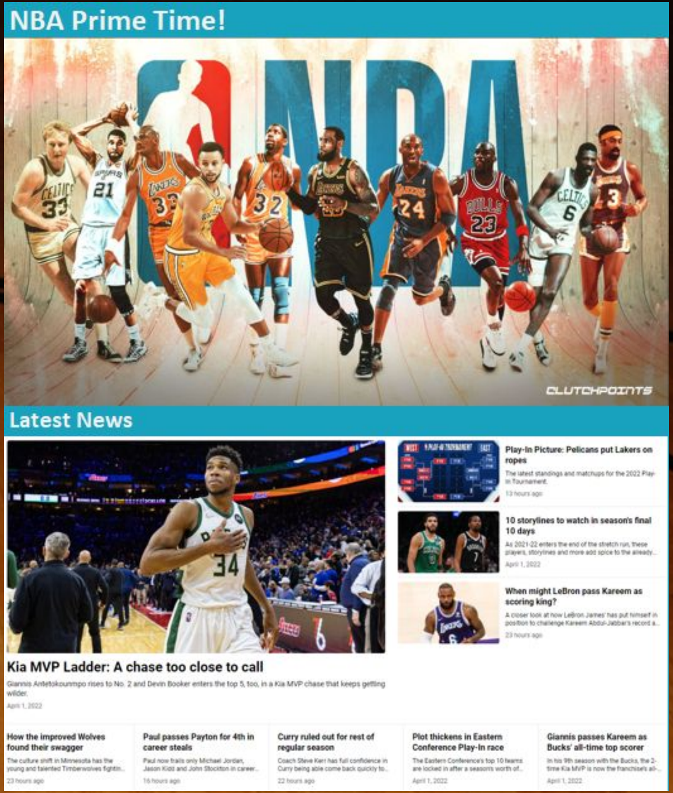
NBA Prime Time!

Navigation Bar

Page Header: NBA Final Project

Latest News

Mockup Page



NBA Prime Time!

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