Vehicle Safety Ratings

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Outline

- Which types/make/model of vehicles are more safe?
- Dataset, terms descriptions
- Datasource
- Results
- Interactive visualizations
- Appendix

Which types of vehicles are more safe?

- Test crashes & safety features
  - Available at National Highway Traffic Security Administration (NHTSA)

- Real-world crash data

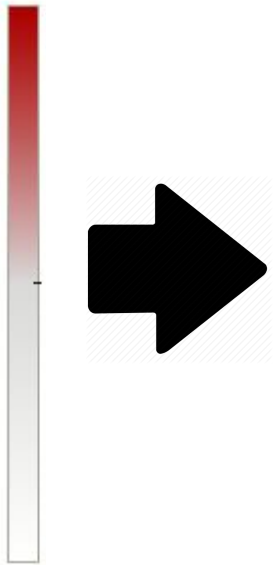
Accidents

- Data: Reported accidents from police officers in the United States for years 2016, 2017 and 2018
  - Fatalities, injuries
  - Property damage in excess of a predetermined dollar amount
- 196,957 vehicles from 118,462 accidents
- Crash conditions
- Maximum injury level
- Number of persons injured & Number of occupants in a vehicle
- Injury Severity rate
- Weighted Injury Severity rate
- Relative severity of a crash condition
- Damage over condition
- Safety Rate

Injury severity rate & Weighted Injury Severity rate

Injury Severity rate:

Fatal	100
Serious injury	75
Injured (Severity unknown)	65
Minor injury	50
Possible injury :	25
No injury :	0



Weighted Injury Severity rate:

$$\text{Injury Severity Rate} \times \frac{\text{Number of persons injured in the vehicle}}{\text{Number of occupants in the vehicle}}$$

➢ Represents the damage

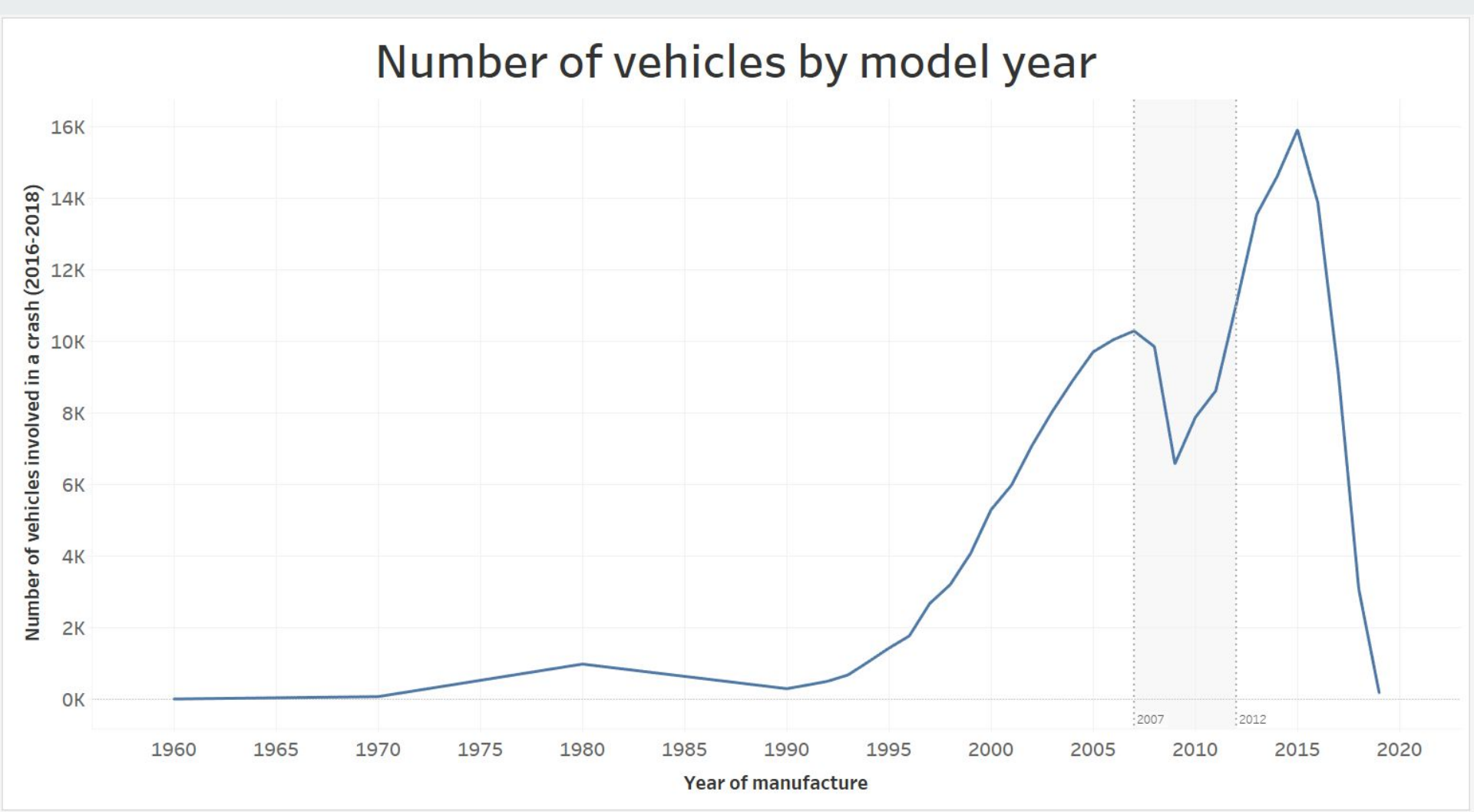
Crash condition & Damage regardless of conditions

- Damage : Weighted Injury Severity Rate
- c_i : Relative severity of a condition
- c_i = Avg. Damage for condition$_i$ − Avg. Damage overall (If there is more than 50 crashes of a condition)
- Crash condition = $\sum_i c_i$
- Damage over condition = Damage − Crash condition
- Damage over condition → Scaling (0,100)

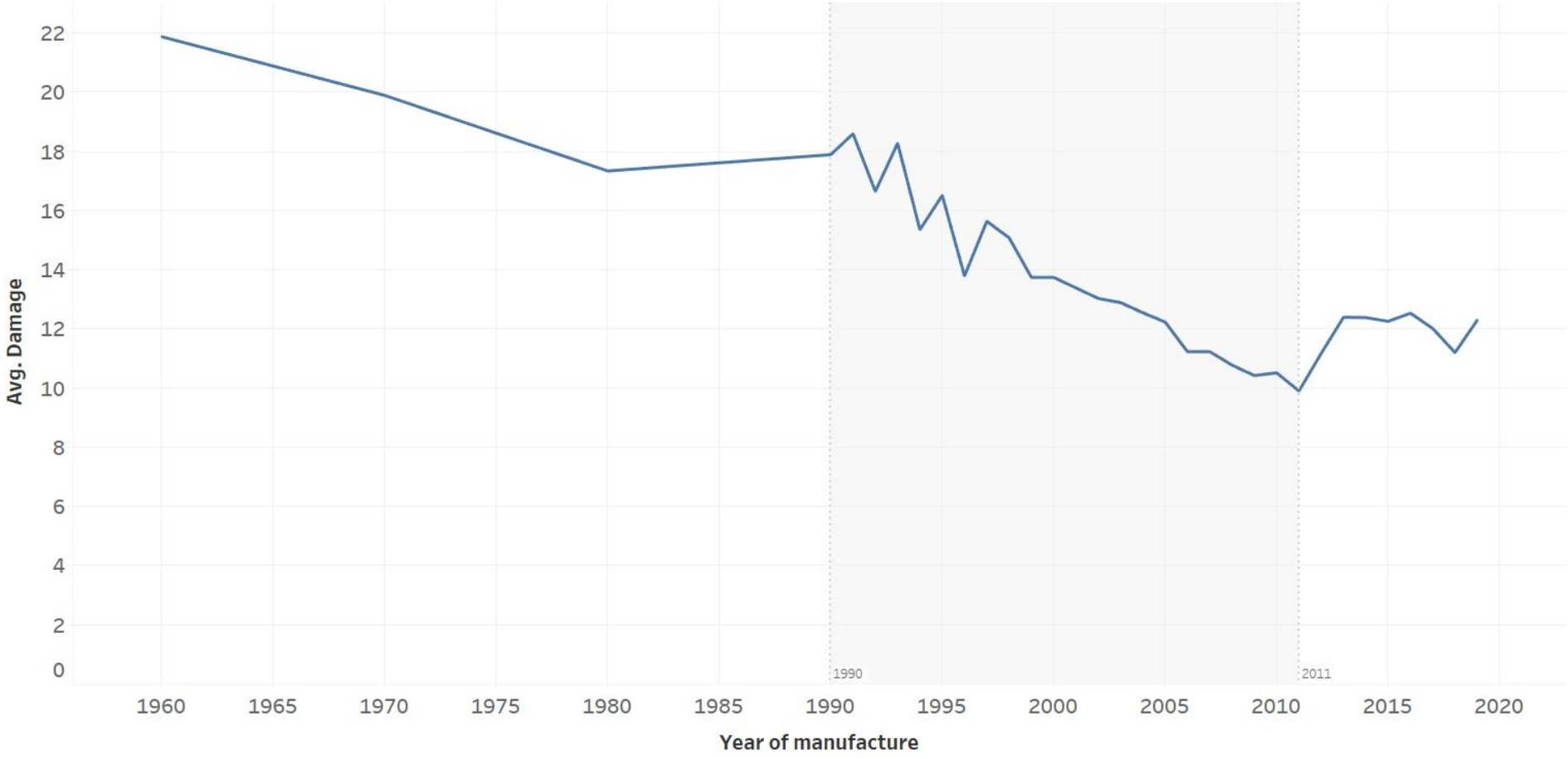
Safety Rate ⇄ Damage regardless of conditions

- Formula:
  - ➢ Safety Rate = 100 - Damage regardless of conditions
- Based on Damage
- Isolated from condition effects

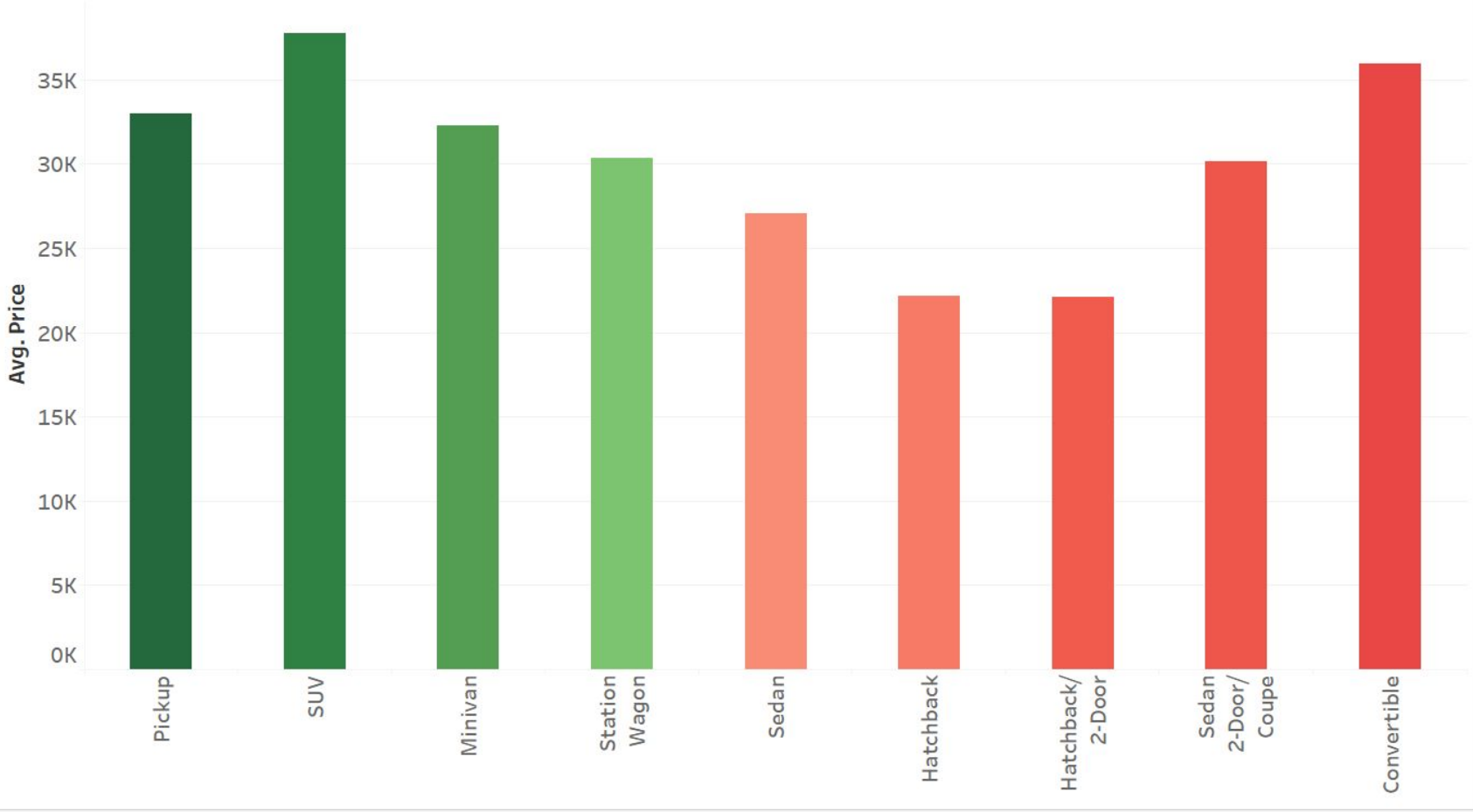
RESULTS


Number of vehicles by model year
Number of vehicles involved in a crash (2016-2018)
16K
14K
12K
10K
8K
6K
4K
2K
0K
2007
2012
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Year of manufacture

Average damage by model year



Body Type

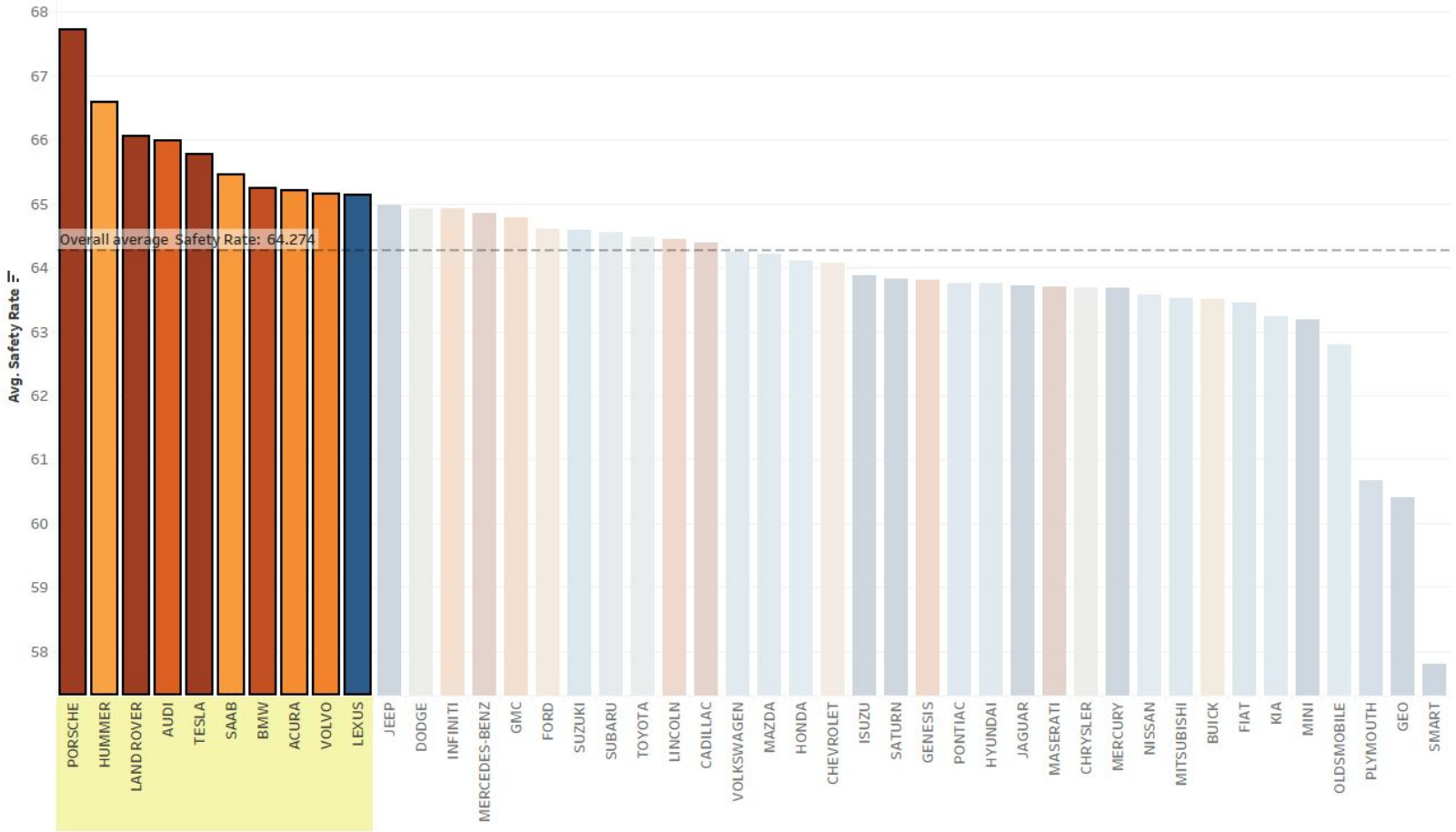


Avg. Safety Rate

63.000 65.000


Price Range
Avg. Safety Rate
62.000
66.000
67.5
67.0
66.5
66.0
65.5
65.0
64.5
64.0
63.5
63.0
62.5
62.0
61.5
Avg. Safety Rate
Overall avarage Safety Rate: 64.060
15K
45K
10K
20K
30K
40K
50K
60K
70K
80K
90K
100K
110K
120K
130K
140K
150K
160K
Price

Make



Avg. Price

0 60,000

Body Type

- [x] (All)
- [x] Convertible
- [x] Hatchback
- [x] Hatchback/ 2-Door
- [x] Minivan
- [x] Pickup
- [x] Sedan
- [x] Sedan 2-Door/ C...
- [x] Station Wagon
- [x] SUV

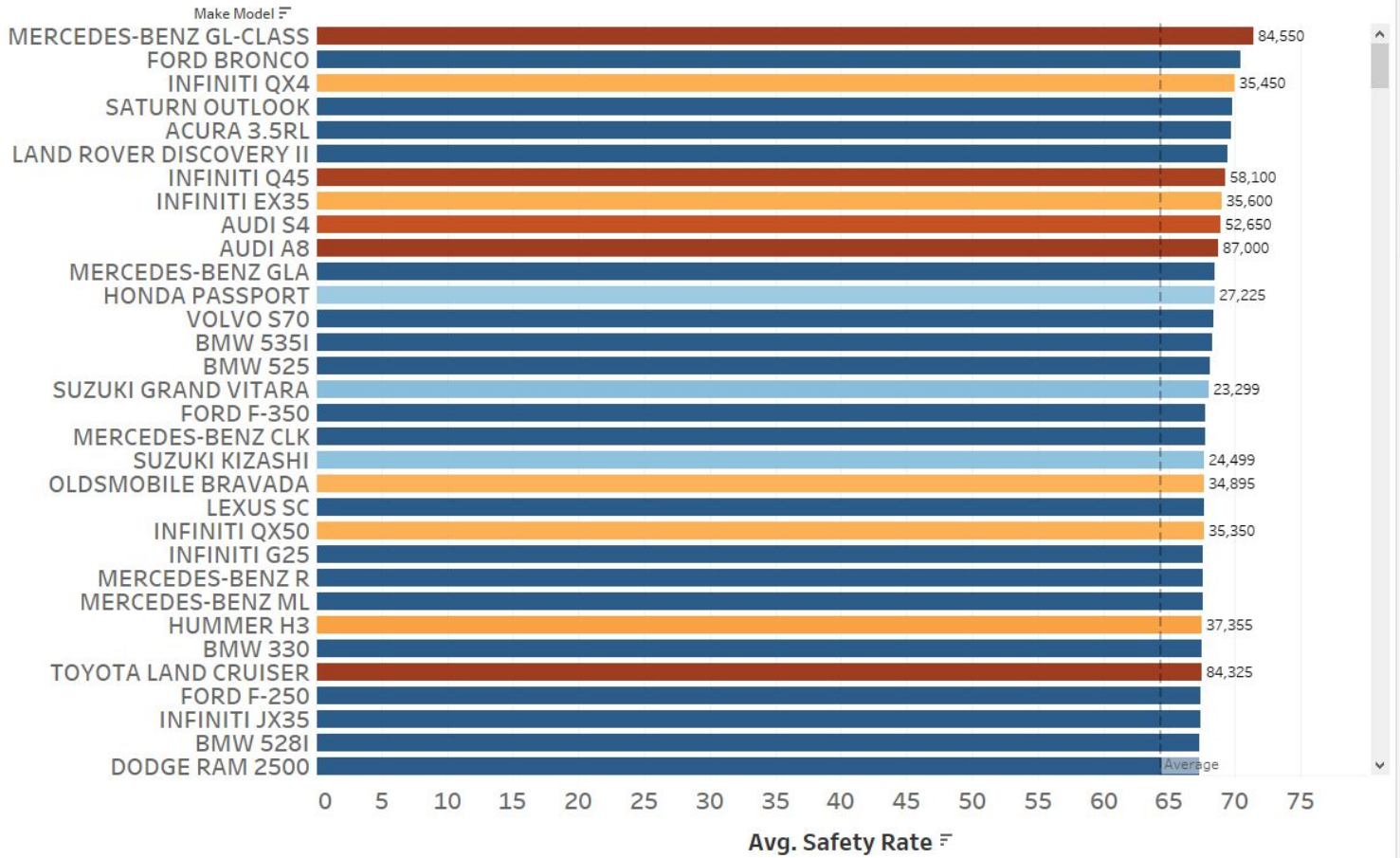
Model Year

1966 2019

Count of crashes / Make

15 31,547

Make Model

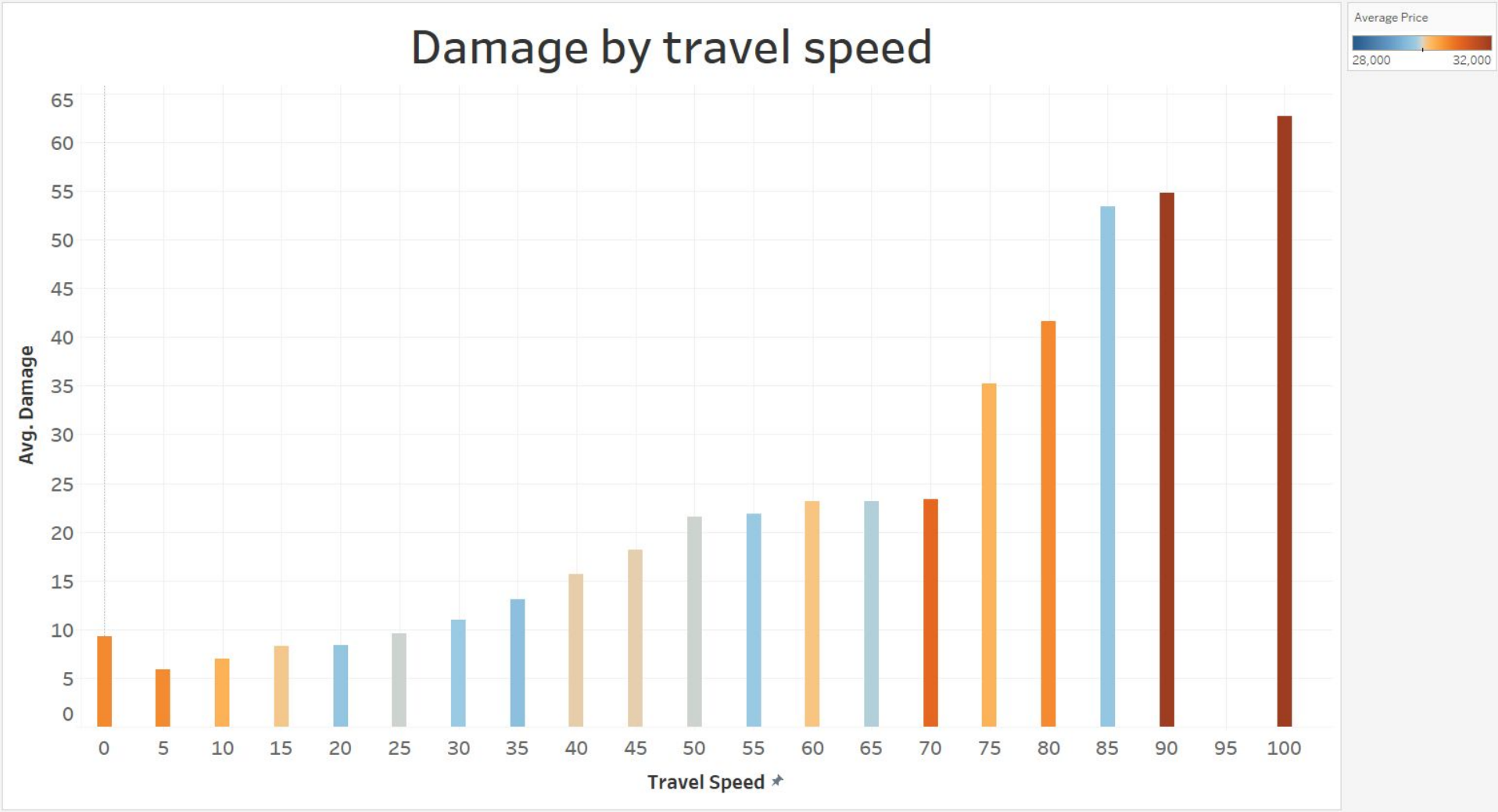


Body Type

- [x] (All)
- [x] Convertible
- [x] Hatchback
- [x] Hatchback/ 2-Door
- [x] Minivan
- [x] Pickup
- [x] Sedan
- [x] Sedan 2-Door/ Coupe
- [x] Station Wagon
- [x] SUV

Avg. price

0 60,000


Damage by travel speed
Average Price
28,000
32,000
Avg. Damage
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Travel Speed

DATASOURCE

- Accident & vehicle dataset:
  - ftp://ftp.nhtsa.dot.gov/
- VIN decode API:
  - https://vpic.nhtsa.dot.gov/api/
- Car features and MSRP:
  - https://www.kaggle.com/CooperUnion/cardataset/data

INTERACTIVE DASHBOARD

APPENDIX

Crash condition & Damage regardless of conditions

This metric represents the severity of the condition in which the accident occured.

1. Average **Weighted Injury Severity rate (Damage)** calculated for each condition
2. Compared the average of individual condition with the average of overall
3. Severity of each condition is different
4. Extracted the severity of conditions from Damage
5. New metric created: **Damage regardless of conditions**
6. Normalized range: 0 -> 100

Weather condition

This data element records the prevailing atmospheric conditions that existed at the time of the crash as indicated in the police crash report.

0	No Additional Atmospheric Conditions
1	Clear
2	Rain
3	Sleet or Hail
4	Snow
5	Fog, Smog, Smoke
6	Severe Crosswinds
7	Blowing Sand, Soil, Dirt
8	Other
10	Cloudy
11	Blowing Snow
12	Freezing Rain or Drizzle
98	Not Reported
--	Unknown
99	Reported as Unknown

Light condition

This data element records the type/level of light that existed at the time of the crash as indicated in the police crash report.

1	Daylight
2	Dark – Not Lighted
3	Dark – Lighted
4	Dawn
5	Dusk
6	Dark – Unknown Lighting
7	Other
8	Not Reported
--	Unknown
9	Reported as Unknown

MFACTOR

This data element describes this vehicle's possible pre-existing defects or maintenance conditions that may have contributed to the crash.

0	None
1	Tires
2	Brake System
3	Steering System-Tie Rod, Kingpin, Ball Joint, etc.
4	Suspension-Springs, Shock Absorbers, McPherson Struts, Control Arms, etc.
5	Power Train-Universal Joint, Drive Shaft, Transmission, etc.
6	Exhaust System
7	Headlights
8	Signal Lights
9	Other Lights
10	Wipers
11	Wheels
12	Mirrors
13	Windows/Windshield
14	Body, Doors
15	Truck Coupling/Trailer Hitch/Safety Chains
16	Safety Systems
17	Vehicle Contributing Factors-No Details
97	Other
98	Not Reported
--	Unknown
99	Reported as Unknown

VEVENT_IM

This data element describes the event that resulted in the most severe injury or, if no injury, the greatest property damage involving this vehicle.

2016	2017	2018-Later	
NONCOLLISION			
1	1	1	Rollover/Overturn
2	2	2	Fire/Explosion
3	3	3	Immersion or Partial Immersion
4	4	4	Gas Inhalation
5	5	5	Fell/Jumped from Vehicle
6	6	6	Injured in Vehicle *(Non-Collision)*
7	7	7	Other Noncollision
16	16	16	Thrown or Falling Object
44	44	44	Pavement Surface Irregularity *(Ruts, Potholes, Grates, etc.)*
51	51	51	Jackknife *(Harmful to This Vehicle)*
72	72	--	Cargo/Equipment Loss or Shift *(Harmful to This Vehicle)*
--	--	72	Cargo/Equipment Loss, Shift, or Damage *(Harmful)*
COLLISION WITH MOTOR VEHICLE IN TRANSPORT			
12	12	12	Motor Vehicle In-Transport
54	54	54	Motor Vehicle In-Transport Strikes or is Struck by Cargo, Persons or Objects Set-in-Motion from/by Another Motor Vehicle In-Transport
55	55	55	Motor Vehicle in Motion Outside the Trafficway
COLLISION WITH OBJECT NOT FIXED			
8	8	8	Pedestrian
9	9	9	Pedalcyclist
10	10	10	Railway Vehicle
11	11	11	Live Animal
14	14	14	Parked Motor Vehicle
15	15	15	Non-Motorist on Personal Conveyance
18	18	18	Other Object Not Fixed
45	45	45	Working Motor Vehicle
49	49	49	Ridden Animal or Animal Drawn Conveyance
73	73	73	Object That Had Fallen From Motor Vehicle In-Transport
74	74	74	Road Vehicle on Rails
--	91	91	Unknown Object Not Fixed

2016	2017	2018-Later	
COLLISION WITH FIXED OBJECT			
17	17	17	Boulder
19	19	19	Building
20	20	20	Impact Attenuator/Crash Cushion
21	21	21	Bridge Pier or Support
23	23	23	Bridge Rail *(Includes Parapet)*
24	24	24	Guardrail Face
25	25	25	Concrete Traffic Barrier
26	26	26	Other Traffic Barrier
30	30	30	Utility Pole/Light Support
31	31	31	Post, Pole or Other Support
32	32	32	Culvert
33	33	33	Curb
34	34	34	Ditch
35	35	35	Embankment
38	38	38	Fence
39	39	39	Wall
40	40	40	Fire Hydrant
41	41	41	Shrubbery
42	42	42	Tree *(Standing Only)*
43	43	43	Other Fixed Object
46	46	46	Traffic Signal Support
48	48	48	Snow Bank
50	50	50	Bridge Overhead Structure
52	52	52	Guardrail End
53	53	53	Mail Box
57	57	57	Cable Barrier
58	58	58	Ground
59	59	59	Traffic Sign Support
--	93	93	Unknown Fixed Object
99	99	--	Unknown
--	--	99	Reported as Unknown

IMPACT1_IM

This data element identifies the area on this vehicle that produced the first instance of injury to non-motorists or occupants of this vehicle, or that resulted in the first instance of damage to other property or to this vehicle.

0	Non-Collision
1-12	Clock points
13	Top
14	Undercarriage
18	Cargo/Vehicle Parts Set-In-Motion
19	Other Objects Set-In-Motion
20	Object Set in Motion, Unknown if Cargo/Vehicle Parts or Other
61	Left
62	Left-Front Side
63	Left-Back Side
81	Right
82	Right-Front Side
83	Right-Back Side
98	Not Reported
--	Unknown
99	Reported as Unknown

TRAVEL SPEED

This data element records the speed the vehicle was traveling prior to the occurrence of the crash as reported by the investigating officer.

0	Stopped Motor Vehicle in Transport
1-151	Reported Speed Up to 151 mph
997	Speed Greater than 151 mph
998	Not Reported
--	Unknown
999	Reported as Unknown

V_ALCOHOL

This data element records alcohol use for drivers, pedestrians, cyclists and other types of non-motorists (except occupants of motor vehicles not in-transport) involved in the crash. The data element is derived from “Police-Reported Alcohol Involvement” in the Person data file.

1	Alcohol Involved
2	No Alcohol Involved
8	No Applicable Person
9	Unknown

VSURCOND

This data element identifies the attribute that best represents the roadway surface condition prior to this vehicle's critical precrash event.

0	Non-Trafficway or Driveway Access
1	Dry
2	Wet
3	Snow
4	Ice/Frost
5	Sand
6	Water *(Standing or Moving)*
7	Oil
8	Other
10	Slush
11	Mud, Dirt, Gravel
98	Not Reported
--	Unknown
99	Reported as Unknown