



# SALARY BUDGET SIMULATOR FOR CITY OF MADISON

-By Xi He



# Reading Complex Data Set

- Month information is in the first row
- Data recorded horizontally
- Inconsistent Position Names

March				April			
Employee #	Filled Position Description	Filled FTE Percent	Current Salary	Employee #	Filled Position Description	Filled FTE Percent	Current Salary
3504	ASST CITY ATTY	1.00	143,627	3504	ASST CITY ATTY	1.00	143,627
2114	LITIGATION ASST 1	1.00	67,232	2114	LITIGATION ASST 1	1.00	67,232
1351	CLERK-TYP 2	1.00	48,896	1351	CLERK-TYP 2	1.00	48,896
3630	ASST CITY ATTY	1.00	144,933	3630	ASST CITY ATTY	1.00	144,933
3074	SECRETARY 3-LEGAL	1.00	59,614	3074	SECRETARY 3-LEGAL	1.00	59,614
2963	ATTY CITY	1.00	160,114	2963	ATTY CITY	1.00	160,114
3669	ASST CITY ATTY	1.00	77,420	3669	ASST CITY ATTY	1.00	77,420
1121	LEGAL OFFICE ASST	1.00	48,065	1121	LEGAL OFFICE ASST	1.00	48,065
2665	SECRETARY 2-LEGAL	1.00	54,038	2665	SECRETARY 2-LEGAL	1.00	54,038
1381	ASST CITY ATTY	1.00	79,743	1381	ASST CITY ATTY	1.00	84,205
1215	ORD REVISIONS SPEC	1.00	60,505	1215	ORD REVISIONS SPEC	1.00	60,505
2320	ASST CITY ATTY	1.00	144,933	2320	ASST CITY ATTY	1.00	144,933
1288	DEPUTY CITY ATTY	1.00	140,171	1288	DEPUTY CITY ATTY	1.00	140,171
1249	SECRETARY 2-LEGAL	1.00	49,623	1249	SECRETARY 2-LEGAL	1.00	49,623
3826	ASST CITY ATTY	1.00	112,182	3826	ASST CITY ATTY	1.00	112,182
2708	ASST CITY ATTY	1.00	110,294	2708	ASST CITY ATTY	1.00	110,294
4087	ASST CITY ATTY	1.00	144,933	4087	ASST CITY ATTY	1.00	144,933
9053	ASST CITY ATTY	1.00	65,755	9053	ASST CITY ATTY	1.00	65,755
4118	SECRETARY 2-LEGAL	1.00	54,038	4118	SECRETARY 2-LEGAL	1.00	54,038
1159	ASST CITY ATTY	1.00	88,933	1159	ASST CITY ATTY	1.00	88,933
1032	ALDERMAN	1.00	12,692	1032	ALDERMAN	1.00	12,883
4130	COUNCIL PRES	1.00	15.444	4130	COUNCIL PRESIDENT	1.00	15.676

# Reading Complex Data Set

- Python Codes
- Easy for data analysis

	Location	Position #	Position Description	Current Salary	Filled FTE Percent	Employee #	Month	Year	2019 Budgeted Salary
0	ATTORNEY	1	ASST CITY ATTY	143627	1	3504	March	2017	154755
1	ATTORNEY	2	LITIGATION ASST 1	67231.6	1	2114	March	2017	71788
2	ATTORNEY	3	CLERK-TYP 2	48896.1	1	1351	March	2017	52210
3	ATTORNEY	4	ASST CITY ATTY	144933	1	3630	March	2017	154755
4	ATTORNEY	6	SECRETARY 3-LEGAL	59614.1	1	3074	March	2017	64233
...	...	...	...	...	...	...	...	...	...
72403	POLICE	4778	DETECTIVE 1	VACANT	VACANT	VACANT	February	2019	85781.4
72404	POLICE	4779	POLICE OFFICER	57178.7	1	10680	February	2019	51750
72405	POLICE	4780	HR SERVS MANAGER	VACANT	VACANT	VACANT	February	2019	43400

CDA

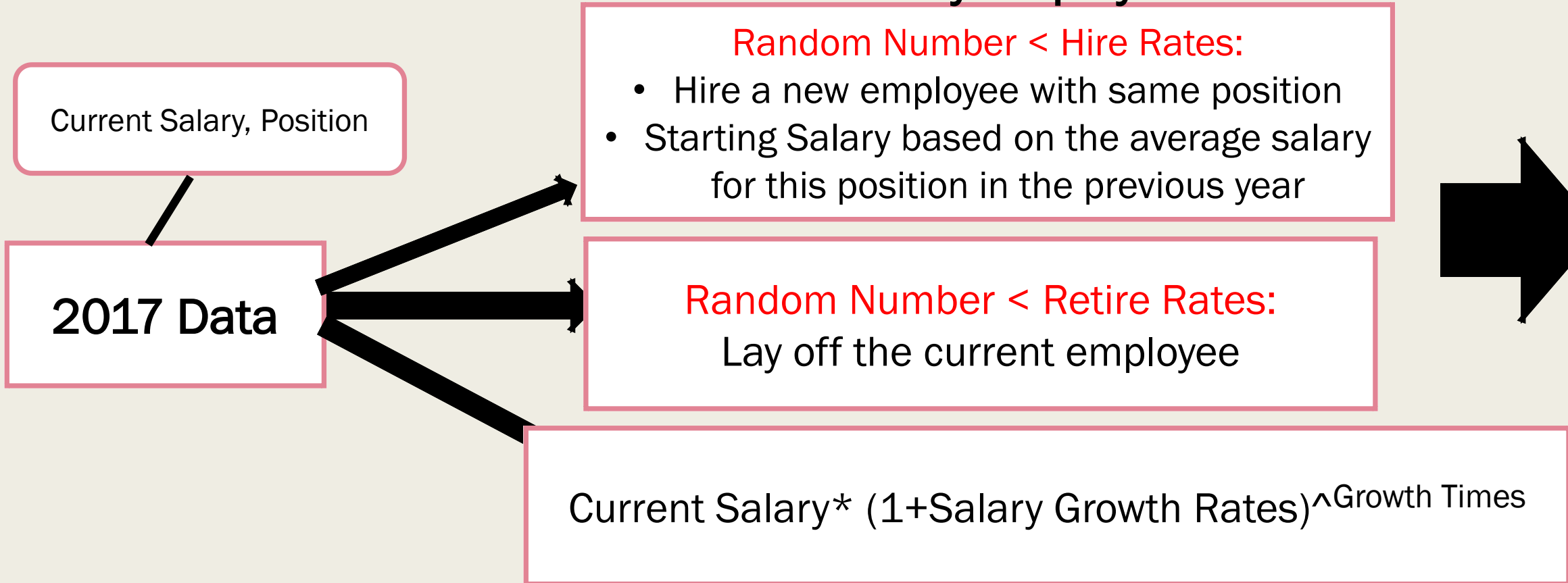
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# Variables in the Budget Simulator

- Hire Rates
  - *Overall Average(≤ 24 available data)*
  - *Based on Positions(>24 available data)*
- Retire Rates
  - *Overall Average(≤ 24 available data)*
  - *Based on Positions(>24 available data)*
- Position of Employees
- Salary Growth Rates (Depends on positions)
- Salary Growth Probability(The number of times salary increased in a year)
- Current Salary

# How To Generate A Salary Budget Simulator

## For Every Employee



# How To Generate A Salary Budget Simulator

Random Number < Hire Rates:

- Hire a current employee
- Starting Salary based on the average salary for this position in the previous year

Random Number < Retire Rates:

Lay off a current employee

• Run 1000 Times

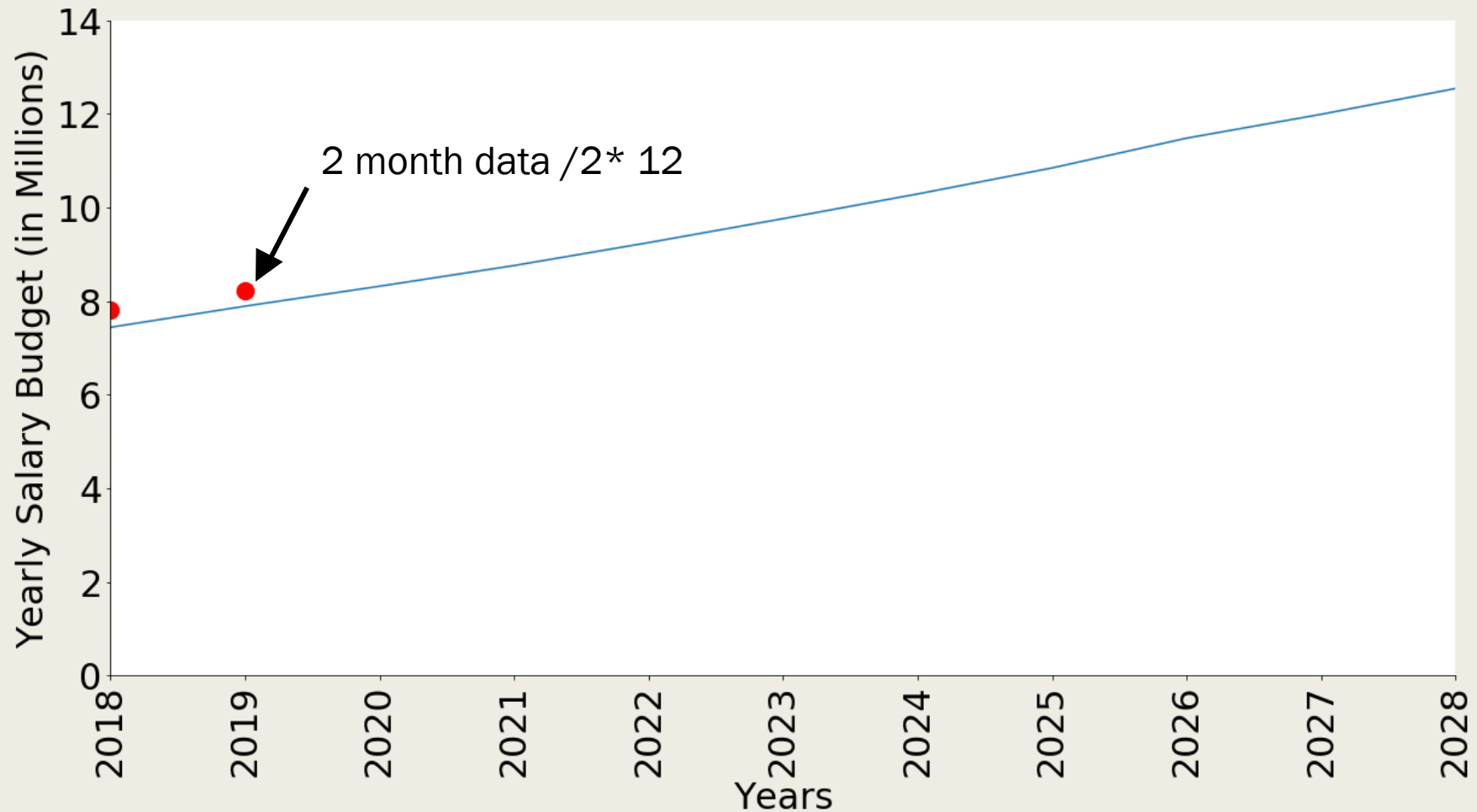
Current Salary\*  $(1 + \text{Salary Growth Rates})^{\text{Growth Times}}$

# How To Generate A Salary Budget Simulator

- Some Data Go Crazy
- \$170 thousands  $\rightarrow$  \$400 thousands 10 years later
- Set Limit:
  - *Current Salary*  $<$  \$50,000  $\rightarrow$  \$100,000
  - $\$50,000 < \text{Current Salary} < \$100,000 \rightarrow \$150,000$
  - *Current Salary*  $>$  \$100,000  $\rightarrow$  \$250,000

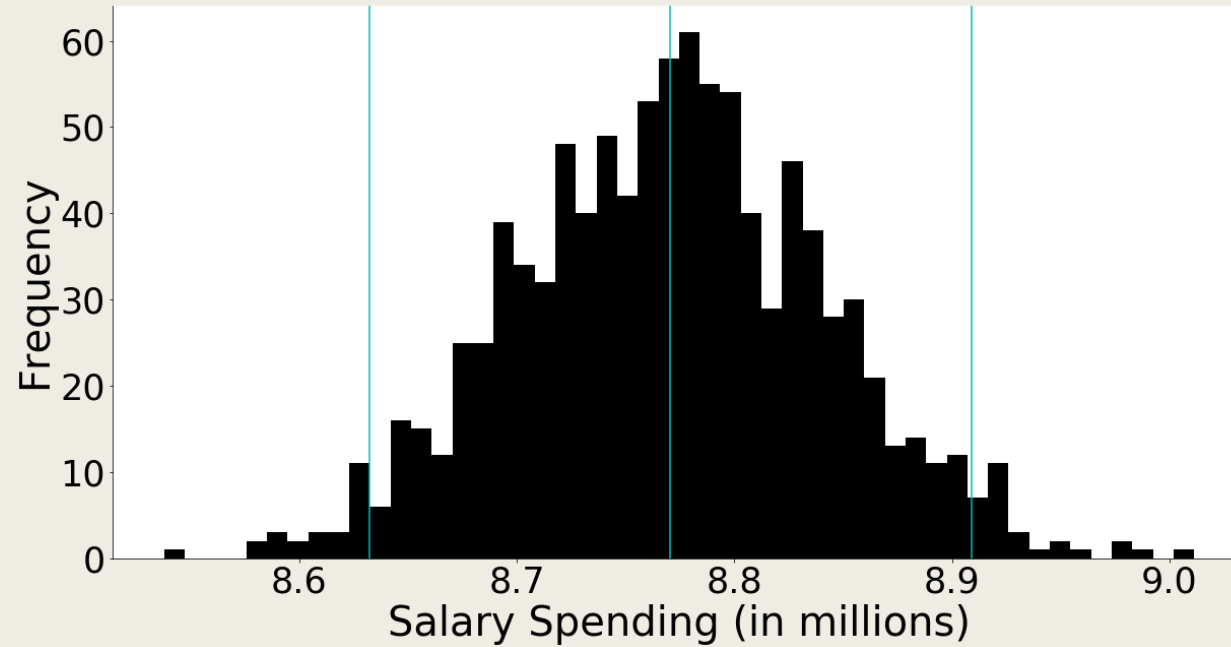
# Result(Engineer Department)

## Yearly Salary Budget vs Year(One Simulation)



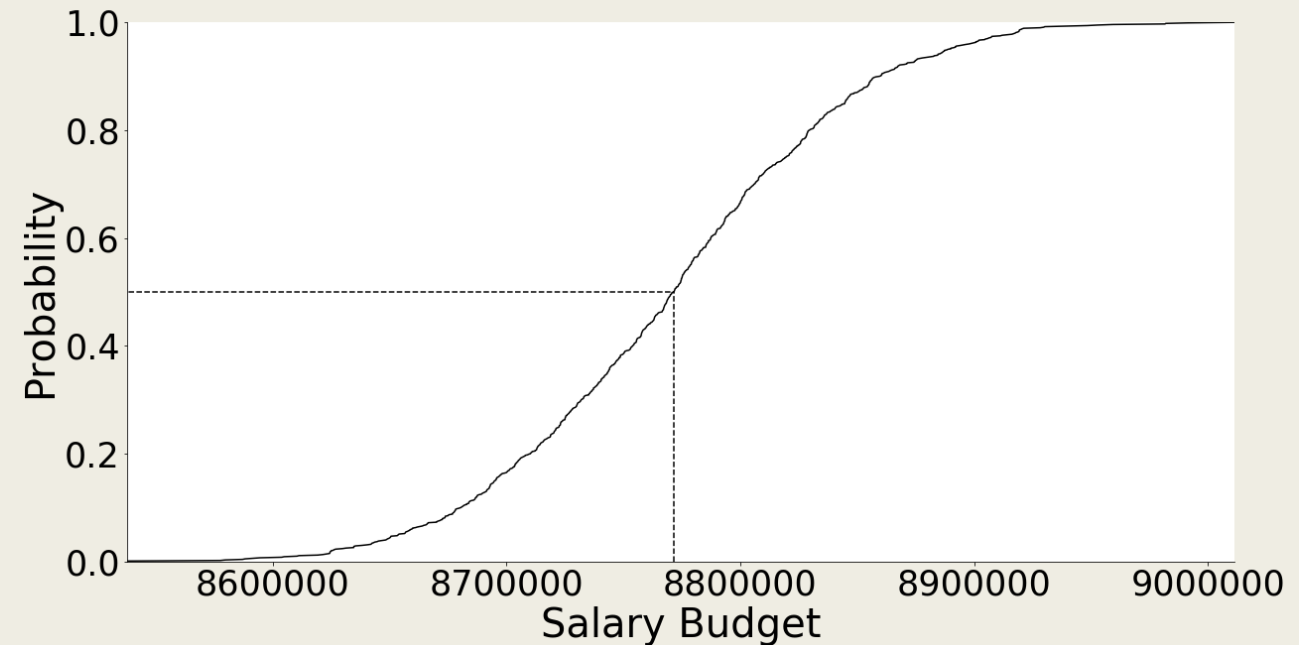


## Salary Simulation for 2020(1000 simulations)

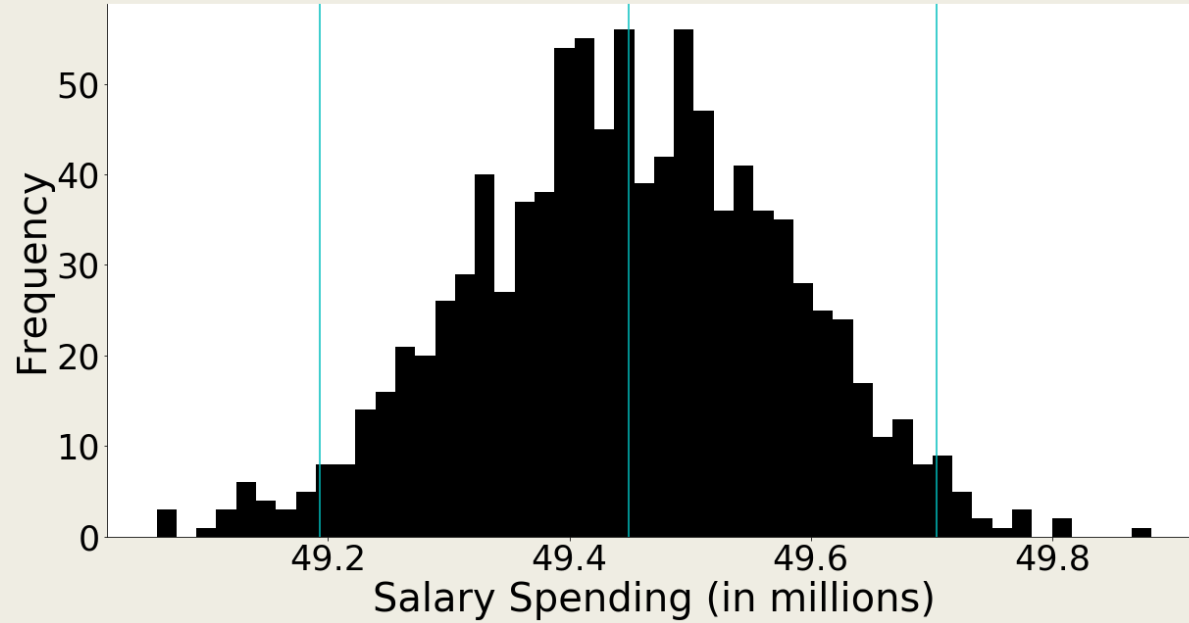


**Engineer Department**

Cumulative Distribution Function(2020)

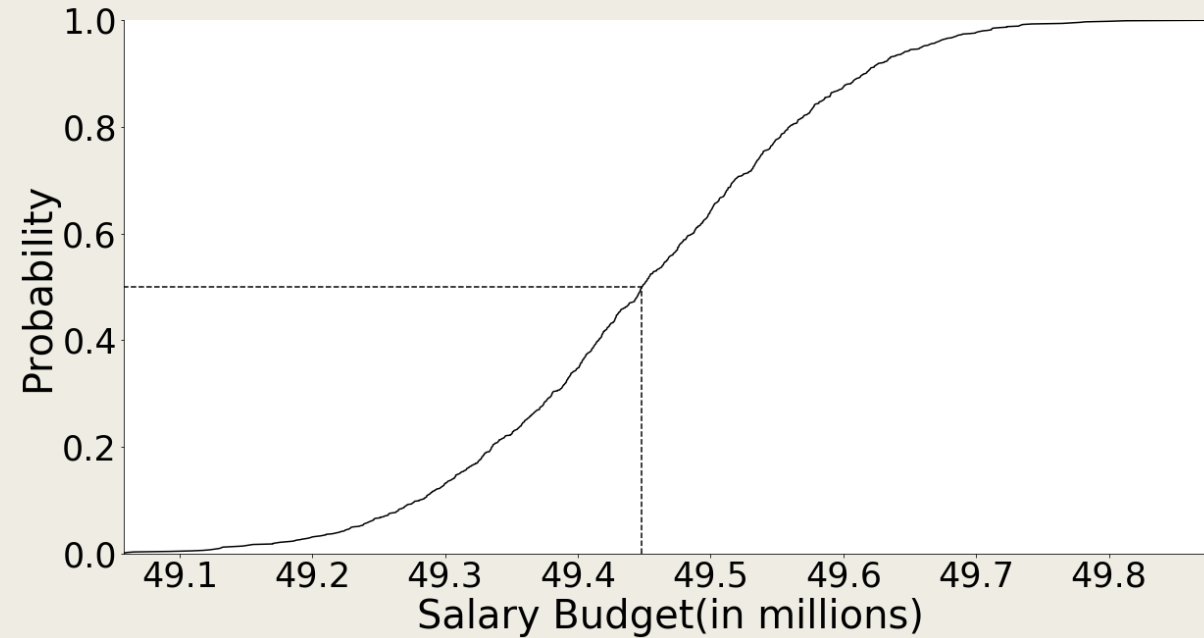


## Salary Simulation for 2020(1000 simulations)

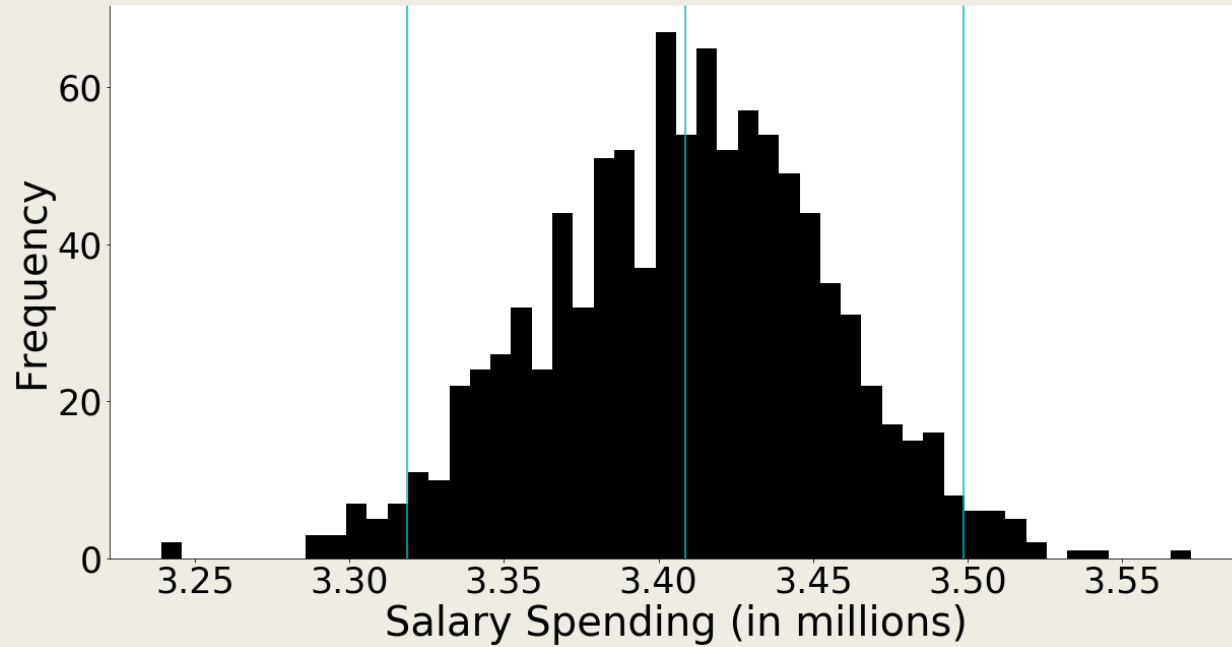


# Police Department

## Cumulative Distribution Function(2020)

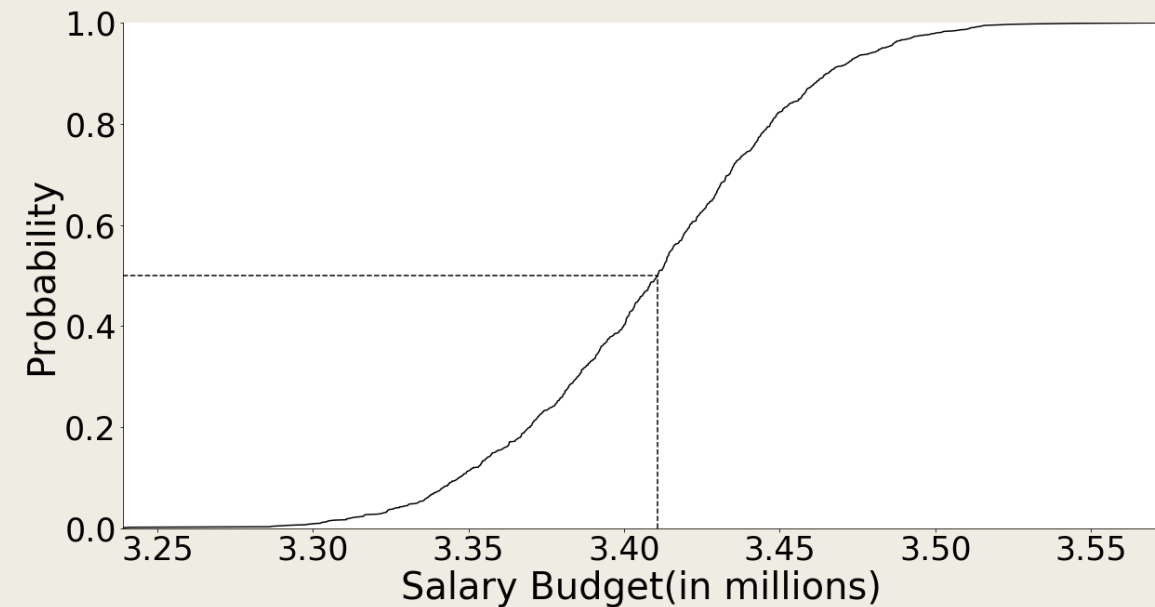


## Salary Simulation for 2020(1000 simulations)



**Finance  
Department**

## Cumulative Distribution Function(2020)



THANK YOU

