# Salary Analysis of Official Jobs in NYC

Business Analytics | Team 16 | Nov 11

**Team Member**

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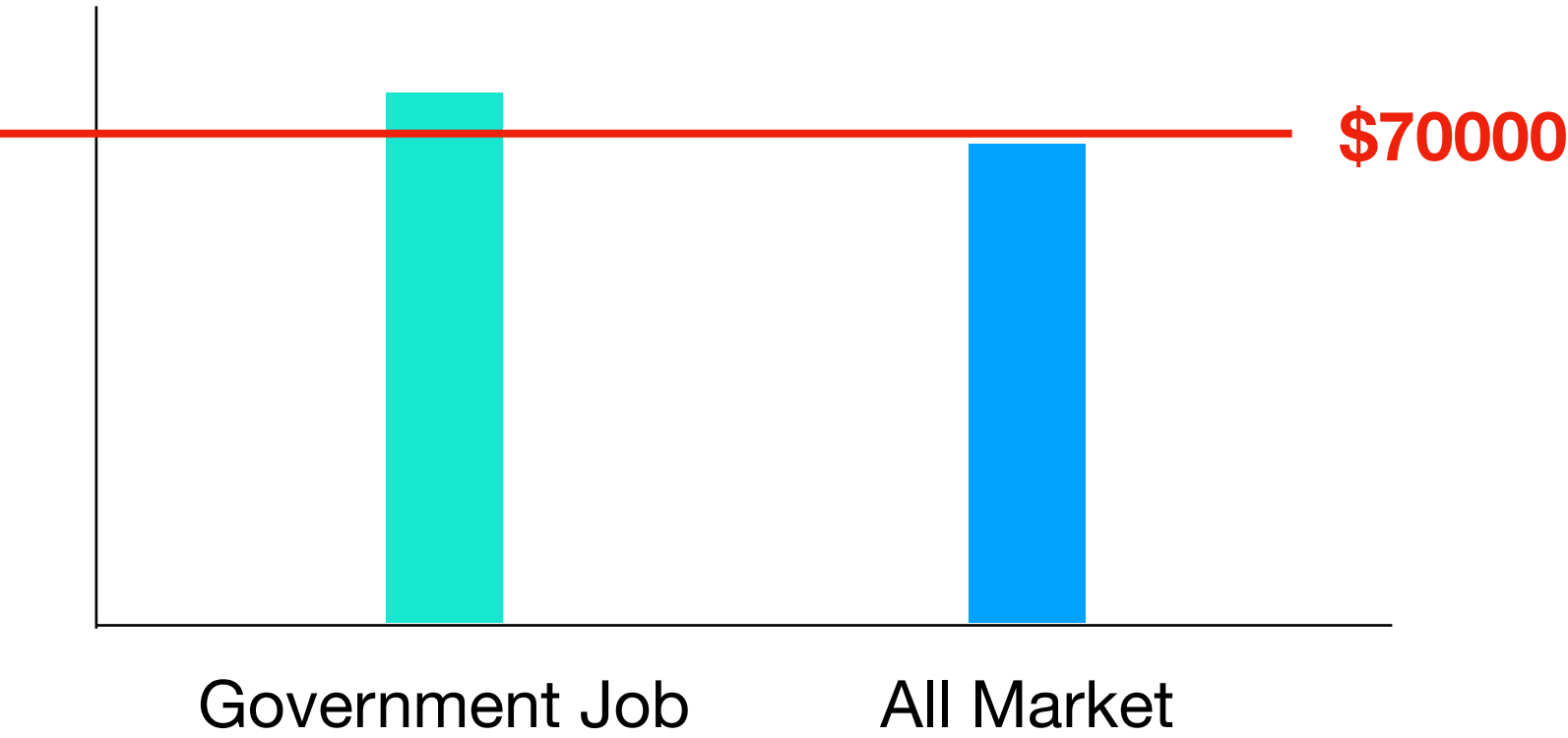
Chongyu He    Xinyi Li

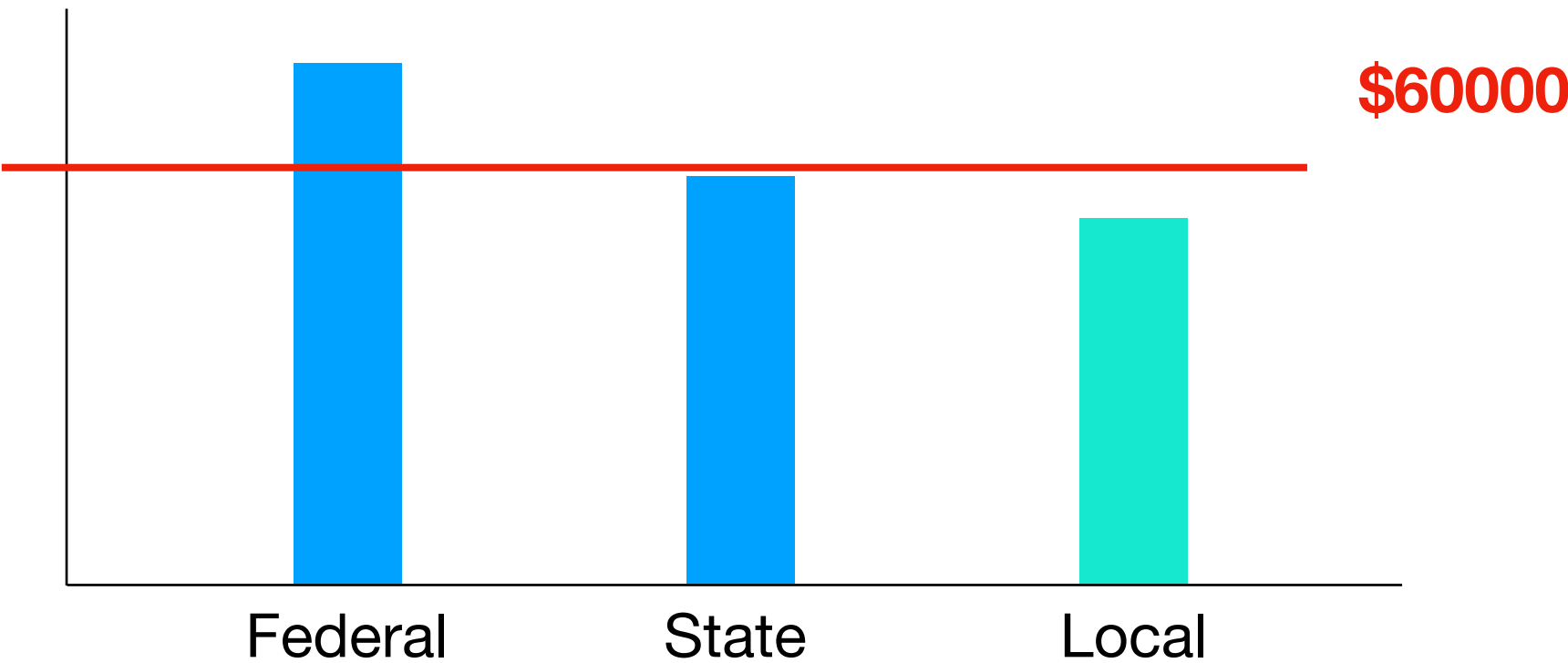Justine Zhang

# Marketing Overview

## 2018 Q2 Annual Salary in New York
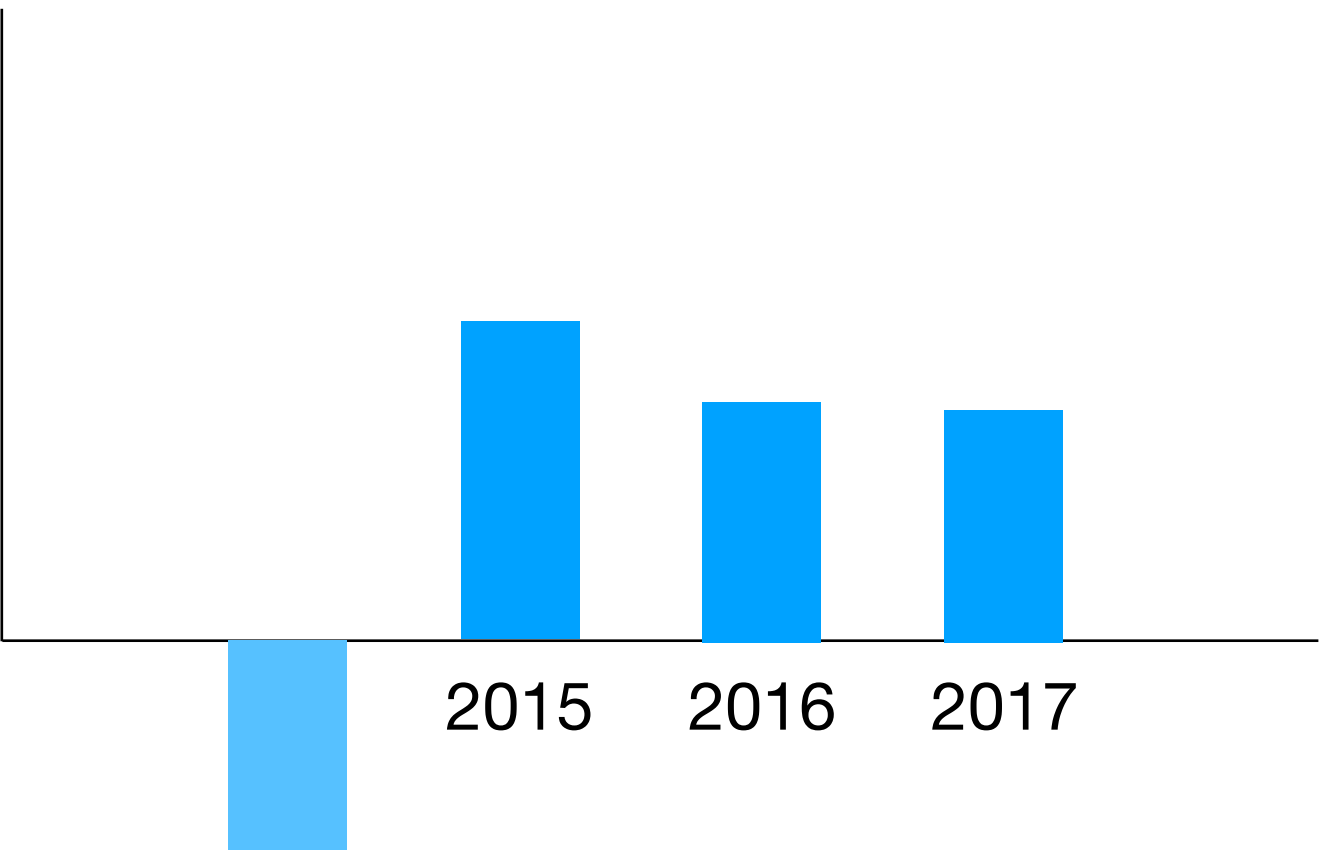
$70000

Government Job    All Market

## 2018 Q2 Annual Salary in Government

$60000

Federal    State    Local

## Demand Added for Government Jobs

2015    2016    2017

Washington D.C.
New York
New Jersey
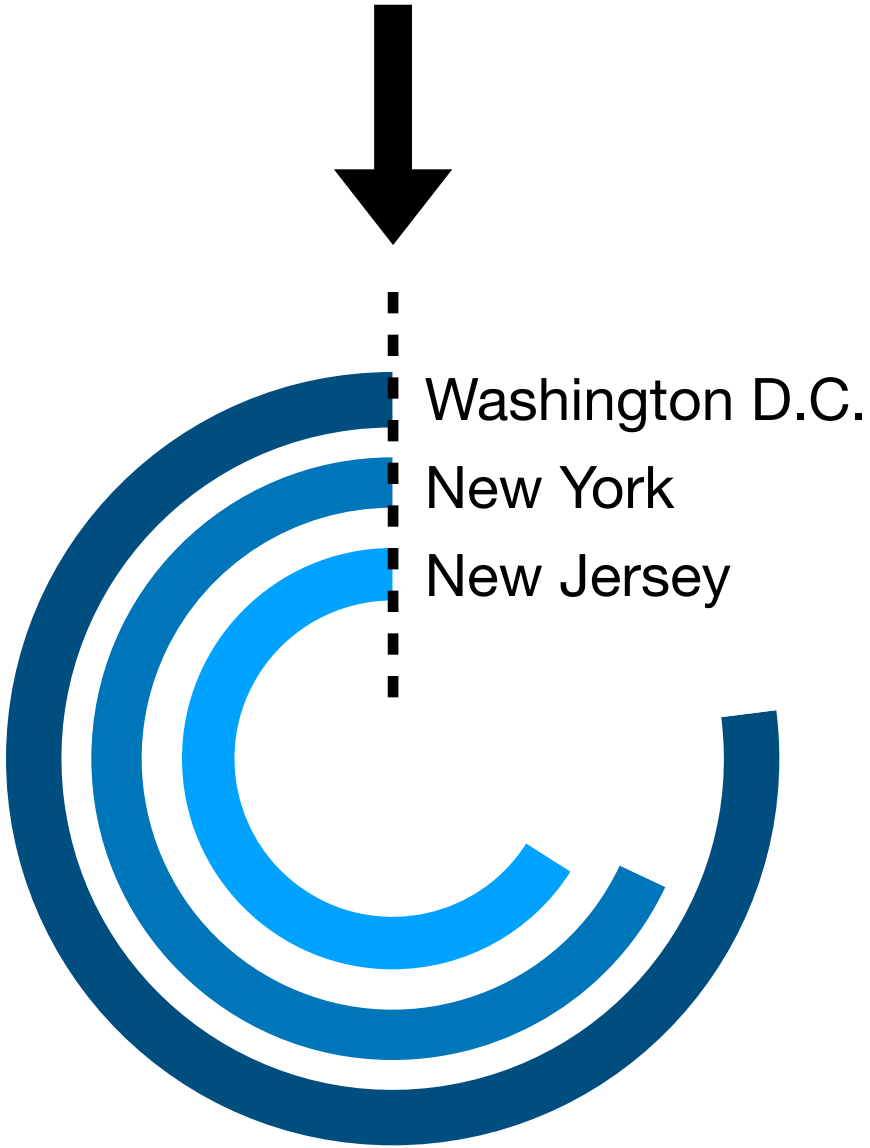
TOP 3 Local Government in Salary

# We conduct three steps to finish the project.

## Collect Dataset

| Dataset | Feature |
|---------|---------|
| Provider | the Department of Citywide Administrative Services (DCAS) |
| Source | the City of New York official jobs site |
| Size | 4000+ Rows 20+ Columns |

## Clean Data

| Column | Cleaning Method |
|--------|-----------------|
| Minimum Qual Requirement | Extract the required work experience and the minimum degree |
| Job Category | Classify the raw data into 13 categories and create corresponding dummy variables |
| Job Level | Classify the job level into 4 categories according to experience level standards |
| Salary | Unify the unit to "Annual" and calculate the average between upper and lower bound |

## Build Models

| Model | Objective |
|-------|-----------|
| Linear Regression | Model the relationship between job salary and possible explanatory variables |
| ANOVA Test | Test differences between multiple means to check whether the variable is significant |
| DiD | Explore the influence of explanatory while ignoring confounding factors |

# We perform linear regression for annual salary on all possible variables.

```
                                         Estimate Std. Error t value Pr(>|t|)
(Intercept)                              38317.98    5582.05   6.864 7.98e-12 ***
year2014                                  -537.01    5811.35  -0.092 0.926381
year2015                                  5140.47    5656.21   0.909 0.363514
year2016                                  6748.53    5329.03   1.266 0.205472
year2017                                 11694.85    5247.07   2.229 0.025894 *
year2018                                 11330.74    5014.03   2.260 0.023900 *
Internal.                                   41.64     713.63   0.058 0.953479
Fulltime.                                 2865.00    1471.57   1.947 0.051635 .
Residency.Require.                      -17098.93     966.10 -17.699  < 2e-16 ***
Administration...Human.Resource          -4917.00    1366.65  -3.598 0.000326 ***
Building.Operations...Maintenance        10124.30    1563.23   6.477 1.08e-10 ***
Communications0.0Intergovernmental0Affairs -1887.41   2506.34  -0.753 0.451474
Community0.0Business0Services             3505.74    6606.62   0.531 0.595704
Constituent0Services0.0Community0Programs -7773.93   1488.79  -5.222 1.89e-07 ***
Engineering.0Architecture.0.0Planning      -12.26    1104.32  -0.011 0.991141
Finance.0Accounting.0.0Procurement        7157.70    1285.40   1.679 0.093324 .
Health                                    1103.68    1086.55   1.016 0.309818
Information0Technology0.0Telecommunications 6991.58   3232.08   2.163 0.030601 *
Legal0Affairs                            10139.63    1473.08   6.883 7.01e-12 ***
Public0Safety.0Inspection.0.0Enforcement -5026.42   1144.56  -4.392 1.16e-05 ***
Policy0.0Analyst                          6443.17    1074.19   5.998 2.22e-09 ***
Social0Services                           -282.91    1818.89  -0.156 0.876407
Technology.0Data0.0Innovation             -513.57    1124.76  -0.457 0.647991
Level                                    11144.26     541.31  20.587  < 2e-16 ***
Degree                                    2799.43     439.26   6.373 2.12e-10 ***
Experience                                3772.89     216.68  17.412  < 2e-16 ***
```

Time

Job Feature

**Annual Salary**

Job Category

Education Requirement

## Linear Regression Equation

**Salary** = 8622 * Agency_category_Legal Affairs - 17099 * Residency Require - 4917 * Administration + 10124 * Building Operations - 7774 * Constituent Services & Community Programs + 10140 * Legal Affairs - 5026 * Public Safety, Inspection & Enforcement + 6443 * Policy Analyst + 11144 * Level + 2799 * Degree + 3772 * Experience + 38317 + …….

# Whether different factors have influence on the difference in salary?

**STEP 1**

Split the entire population into different groups based on a single factor:

- Education level requirement (high school, bachelor, master, doctorate)
- Work experience requirement (6 months, 1, 2, 3, 4, 5, 6, 8, 10 years)
- Level of position (student, entry level, experienced and manager)
- Residency requirement (Yes, No)
- Agency category (Building Operations & Maintenance, Social Services, etc.)
- Year the job was posted (2011 – 2018)

**STEP 2**

Calculate the average salary in different groups

E.g. average salary in groups of high school, bachelor, master, doctorate

**STEP 3**

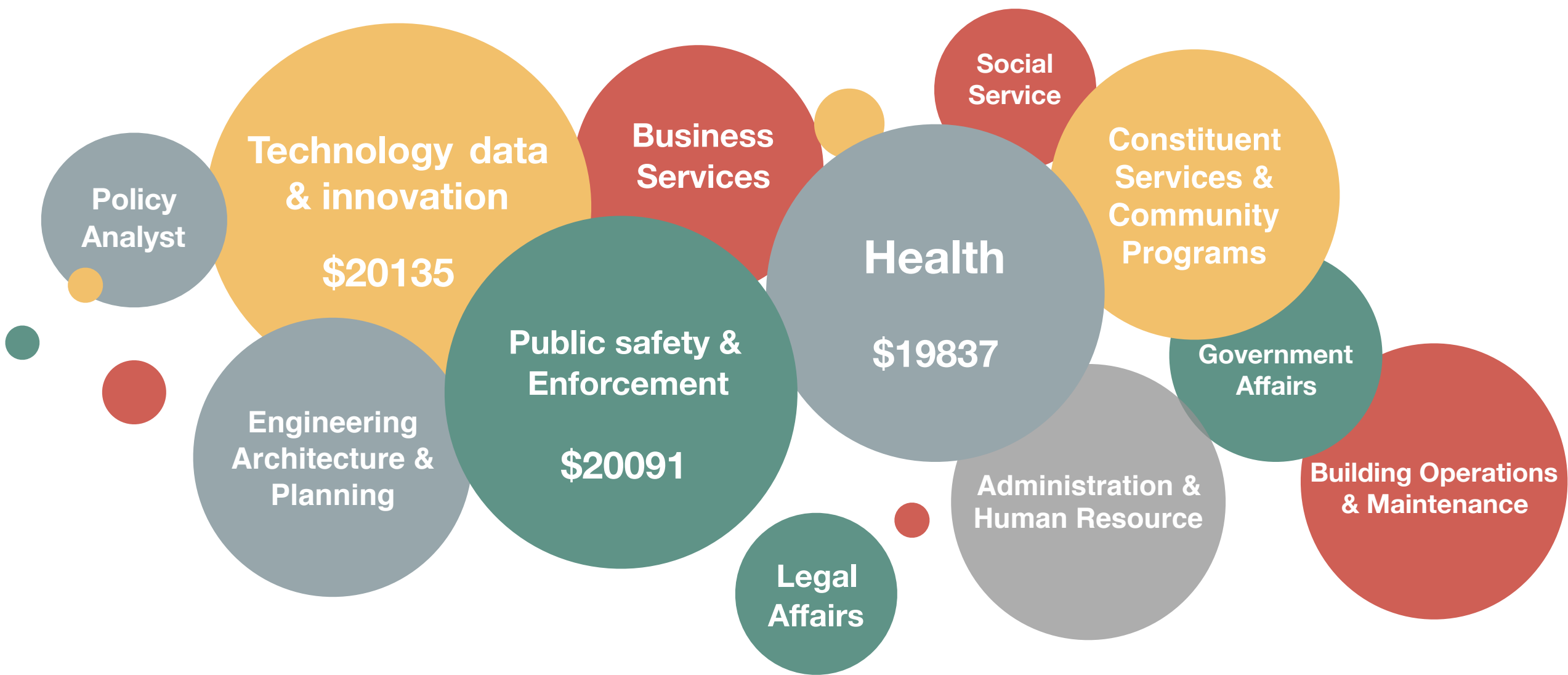Conduct statistical test to test whether the average salaries in different groups are equal

1). if equal, then the factor couldn't influence the salary

2). if unequal, then the factor could influence the salary

**Key Insight**

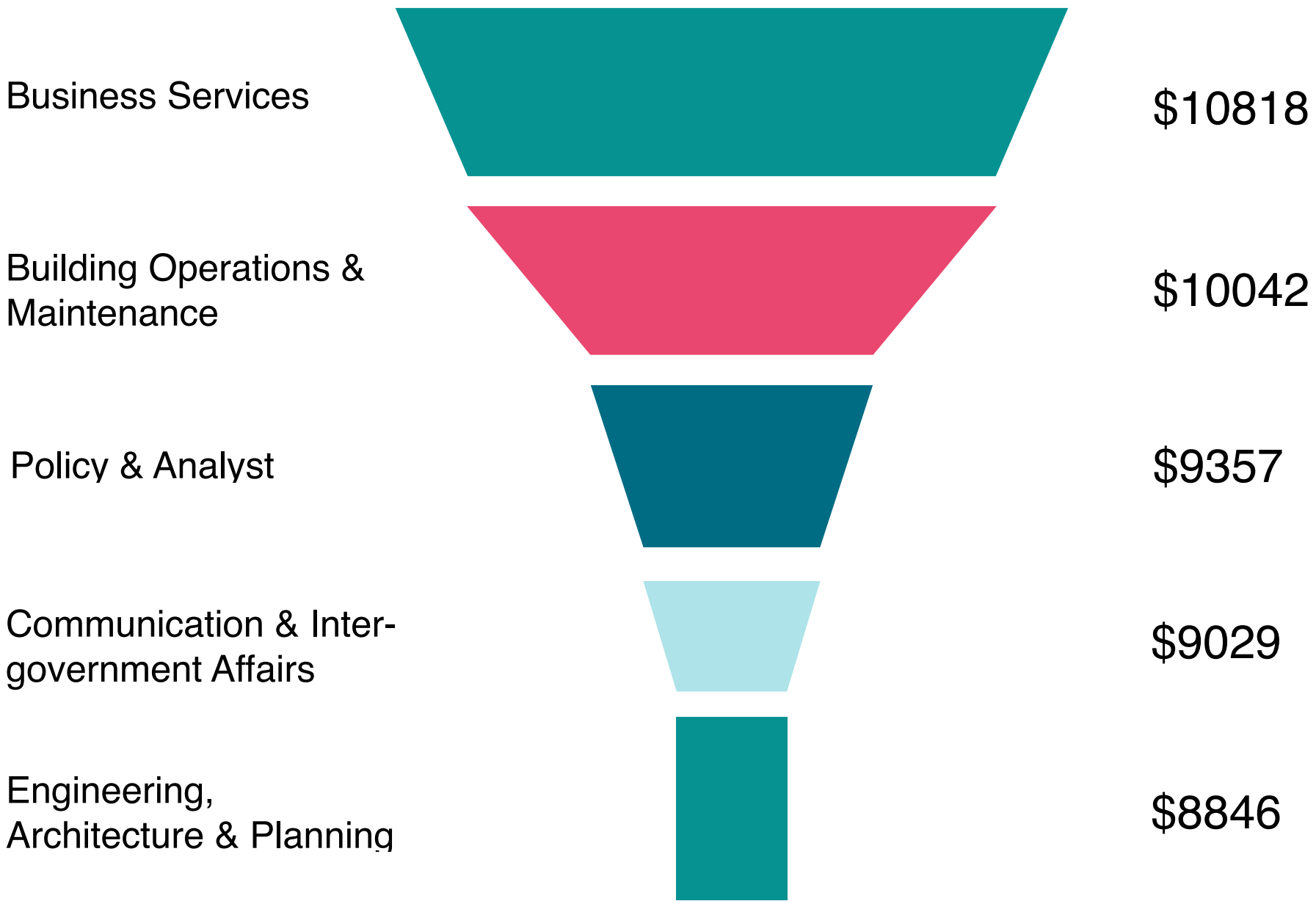All the factors have impact on the difference of salaries.

# In different job categories, the relationship between salary and degree & experience would be different.

**Average salary increase in terms of degree**



**Average salary increase in terms of experience**



Business Services — $10818

Building Operations & Maintenance — $10042

Policy & Analyst — $9357

Communication & Inter-government Affairs — $9029

Engineering, Architecture & Planning — $8846

- From the graph, we can know that for those who want to do jobs related to technology or data analysis, it's essential that they should work hard to get a higher degree so that they could improve their salary a lot.

- The job category 'Technology, data & innovation' has the highest coefficient in degree. The Top 3 categories where salary is influenced by degree mostly are: Technology, data & Innovation, Public safety & Enforcement and Health.

- The job category 'Business Services' has the highest coefficient in experience. It means if a person is doing business services work, this person's salary would increase at the highest rate as his or her working experience increases.

- The Top 3 industries where salary is influenced by experience mostly are: Business Services, Building Operations & Maintenance and Policy, Policy & Analyst.
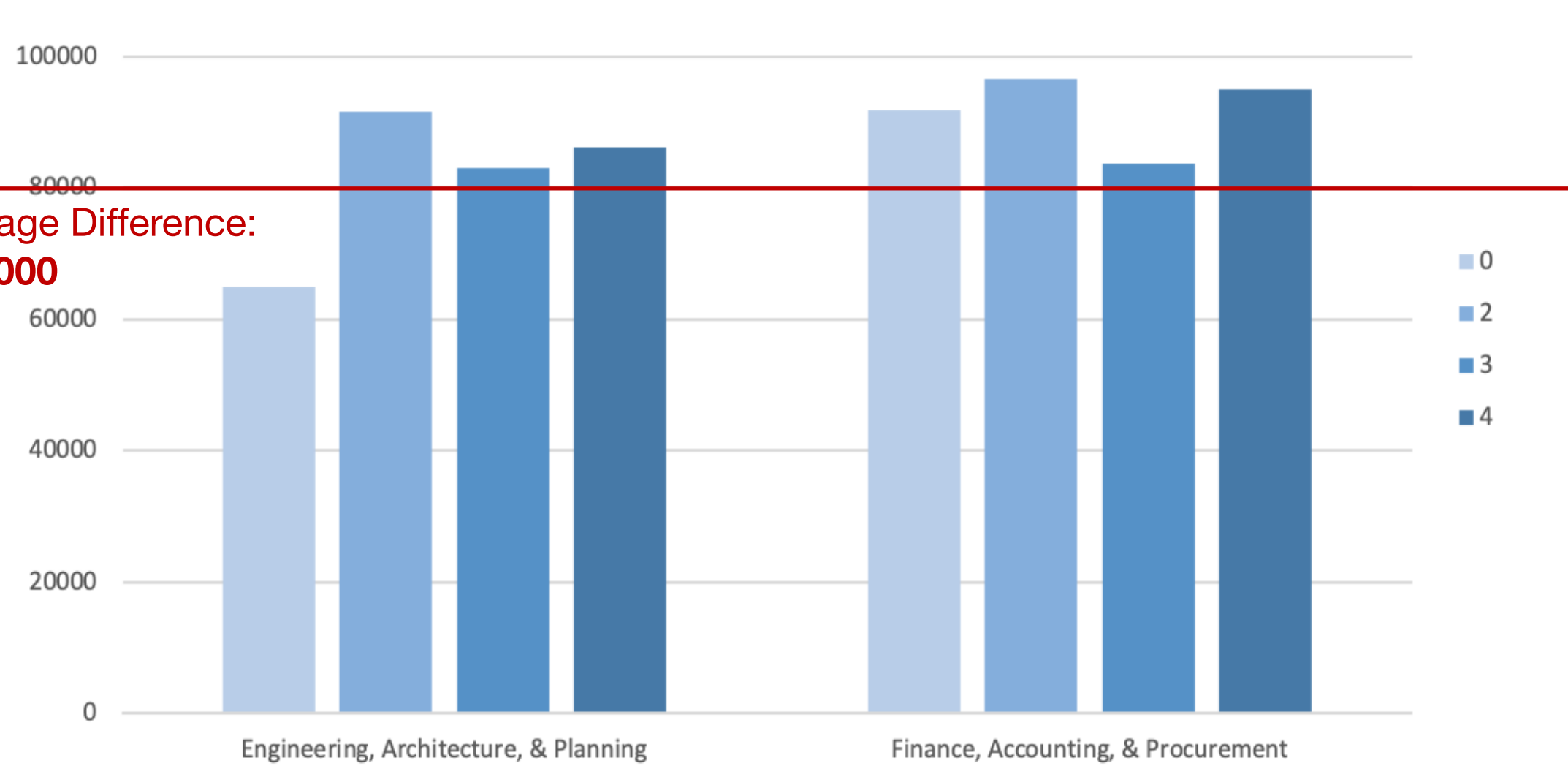
# Bachelor vs. Master

- If I want to work for NYC government, is Master's degree a better choice?

- What costs do I need to consider?

**Salary with Bachelor's degree (under 4-year experience)**
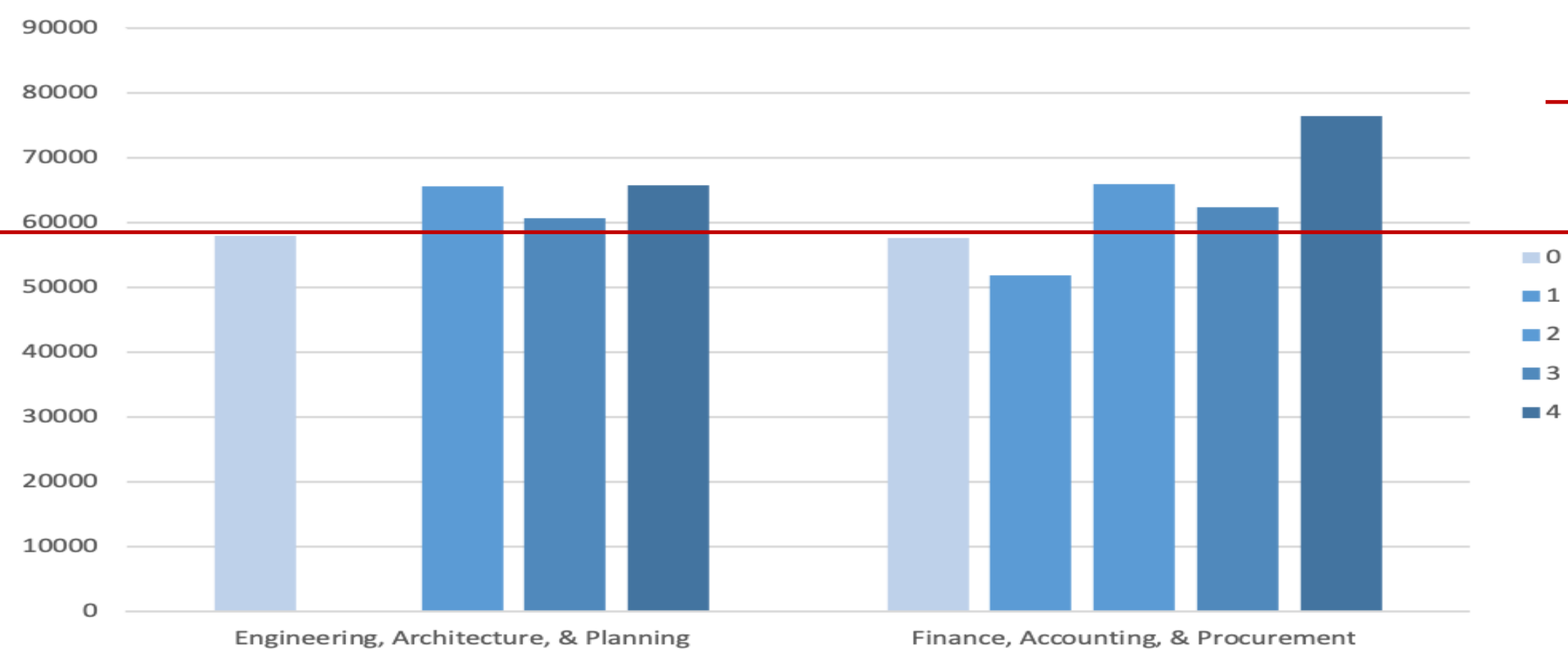


**Salary with Master's degree (under 4-year experience)**



Average Difference: $20,000

**Key Insight**   Comparing to Bachelor's degree, Master's degree seems increase entry-level salary by a **$20,000** amount.

# Gaining a master's degree is not a smart investment for entering NYC government.

Consider cost of a Master's degree (two years):

- Tuitions: $50,000 / year
- Opportunity Cost: Earning about $60,000 per year as an employee with Bachelor's degree

Using linear regression on experience (experience < 8) for different degrees separately, we got salary increasing speed:

- Bachelor: **+ $5,000** / year
- Master: **+ $3,000** / year

| | year 1 | year 2 | year 3 | year 4 | year 5 | year 6 | year 7 | year 8 | … |
|---|---|---|---|---|---|---|---|---|---|
| **Bachelor** | $60,000 | $65,000 | $70,000 | $75,000 | $80,000 | $85,000 | $90,000 | $95,000 | … |
| **Master** | -$50,000 | -$50,000 | $80,000 | $83,000 | $86,000 | $89,000 | $92,000 | $95,000 | … |
| **Net Benefit** | -$110,000 | -$115,000 | $10,000 | $8,000 | $6,000 | $4,000 | $2,000 | $0 | … |
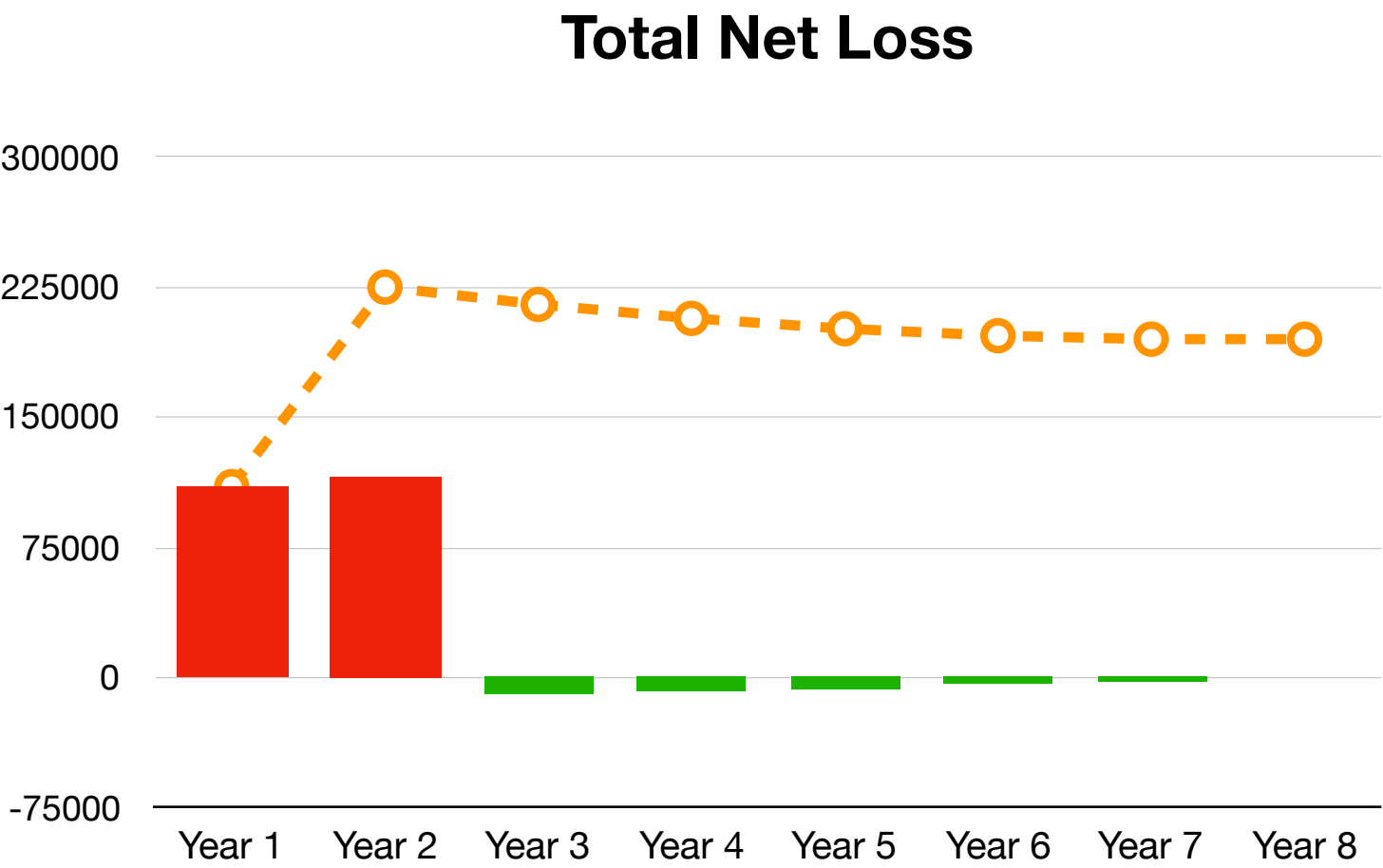
**Total Net Loss**



**Key Insight**   Total net benefit at the end of year 8 is -$195,000.

# Higher degree and more experience helps reduce loss when experiencing government budget shrinkage.

There is a pay cut in 2018 comparing to increasing trend from 2015 to 2017.
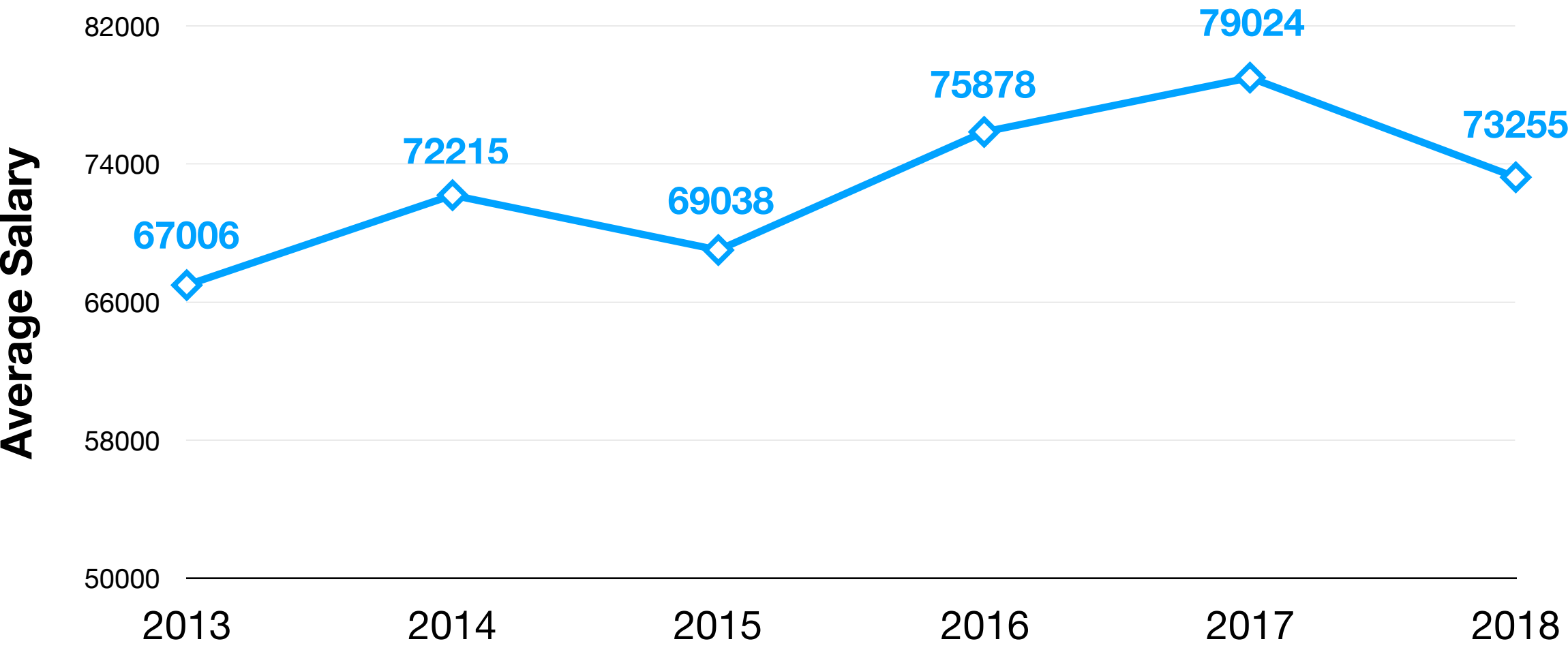


Question: which factor helps reduce loss when experiencing government budget shrinkages? Higher degree or lower degree?

- Train linear regression model on the whole data set.
- Focus on the interactive term.

$$\text{Salary} = \beta_0 + \beta_1 \times y_{2018} + \boxed{\beta_2 \times y_{2018} \times y_{master}} + \ldots$$

$$y_{2018} = \begin{cases} 0 & (\text{Before 2018}) \\ 1 & (\text{After 2018}) \end{cases} \qquad y_{master} = \begin{cases} 0 & (\text{Above Master}) \\ 1 & (\text{Below Master}) \end{cases}$$

```
Coefficients:
                        Estimate Std. Error t value Pr(>|t|)
(Intercept)              60063.1     2378.0  25.258  < 2e-16 ***
PostYear                 -7221.2     2553.9  -2.828 0.004793 **
          ⋮
PostYear:Degree           5078.3    11681.3   0.435 0.663856
PostYear:Experience       2764.5      740.3   3.734 0.000200 ***
```

$\beta_2 > 0 \longrightarrow$ Although the average of salary decreased in 2018, people with a master's degree or above are less affected.

The P-value of "PostYear:Experience" is small & its coefficient is positive $\longrightarrow$ Experience plays a key role in dealing with market fluctuations

**Result** $\qquad \text{Salary} = \beta_0 - 7221.2 \times y_{2018} + 5078.3 \times y_{2018} \times y_{master} + \ldots$

# Conclusion: Work Experience is more important.

**For undergraduate students aiming for working in NYC government**

**For master students**

We recommend that you focus more on accumulating your working experience, and you are more likely to endure market fluctuations with longer working experiences.

It's not necessarily important to get a higher degree to have better salaries, because as your working level increases, the effect of degree on salary goes down dramatically.

You would benefit more by having more working experiences in **Business services**, **Building operation & maintenance** or **Policy & analyst**.

we suggest you to apply for **Technology, data & innovation**, or **Public safety & enforcement**, or **Health** jobs, where you would benefit more with a better education background.

# Q & A