# WHAT DETERMINES NYC OFFICIAL SALARY?

2018/12/11

In the City of New York, there are all kinds of government jobs offered for people. As a part of market, several potential factors influence the salaries for these jobs, like job title, job category, work location, minimum quality requirement, residency requirements and post time.

As for people who aspire to seek for government jobs, it's essential for them to evaluate the expected salary based on their own conditions to have a bright future. As for companies or governments, when they plan to expand its business, the human resource cost is a factor that must be taken into consideration. Therefore, predicting the range of the salary for a certain position given the functionality and other information of the role is essential to both employees and employers. Furthermore, when the government wants to investigate the economy of a certain region, they may not have the complete data for salaries. If we could build up a model to predict the salary, we could also help the government do a better job in being aware of peoples life.

We got a dataset that contains 4000+ rows and 20+ columns about salary and relevant information for different jobs in NYC government from the website "NYC Open Data". For most of the variables (columns), it contains characters, so we need to do some cleaning to ensure the alignment. For example, as for the "Minimum Quality Requirement" column, we find that most of the records describe the work experience and degree level, so we extract these key words and expand them to 2 other columns. Considering "Job Category" or "Job Level" column, we first search for the standards commonly use in the website, then we classify them into these categories and then create dummy variables. In terms of "Salary", we unify the unit to "Annual" and calculate the average between upper and lower bound. For other variables, we simply apply the categorical variables.

We applied multiple data analytic techniques on this data to identify factors that have biggest impact on official salary and disclose different aspects of insights for people who tend to looking for jobs in government.

## NYC Official Salary Mainly Depends on Degree, Experience, Level and Job Category

From job seekers' point of view, they may be willing to know whether different education level and work experience could bring them different salaries. Knowing the result, job seekers could have a better early career plan. Besides, they may also want to know whether different industry would result in different salaries. In order to know whether different external and internal factors would lead to the difference in salaries. We divided all the jobs into different groups based on a single factor. For example, one division is to split the total population into different groups of education requirement (high school, bachelor, master and doctorate). After the division, we set up a statistical test to test whether the average salaries in different groups are equal. We could conclude a single factor is not significant if the statistical test shows the average salaries are equal in all the groups. Otherwise, if the average salaries are not equal in at least two groups, we would say this factor is significant. For example, if the average salaries are the same in all groups of education level, we could show that the education level is not important in making salary different. We did the same test procedure for work experience requirement, level of the position, residency requirement, agency category and the year the job was posted.

For education requirement, we have high school, bachelor, master and doctorate. For work experience requirement, we have 6 months, 1, 2, 3, 4, 5, 6, 8, and 10 years 9 groups. For level of the position, we have “student”, “entry level”, “experienced” and “manager” 4 groups. For residency requirement, we have “required” and “not required” 2 groups. For agency category group, we have “Building Operations & Maintenance”, “Social Services”, “Legal Affairs”, “Constituent Services & Community Programs”, “Health”, “Technology, Data & Innovation”, “Administration & Human Resources”, “Engineering, Architecture, & Planning”, “Policy, Research & Analysis”, “Finance, Accounting, & Procurement”, “Communications & Intergovernmental Affairs” and “Public Safety, Inspections & Enforcement” 12 groups. For year the job was posted, we have 2011 to 2018.

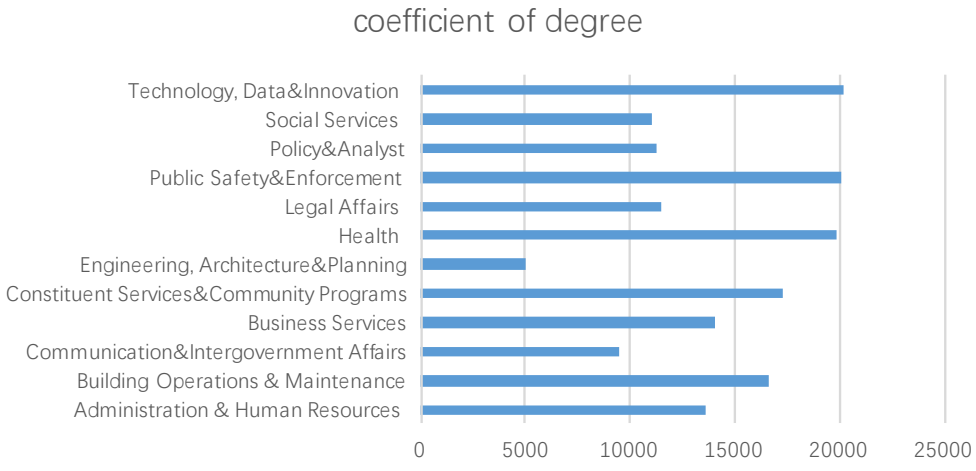
The average salaries are tested to be unequal in 4 education groups, unequal in work experience groups, unequal in position level groups, unequal in residency requirement groups, unequal in agency category groups and unequal in posting year groups. Therefore, we could conclude that education requirement, work experience requirement, position level, residency requirement, agency category and year the job was posted all have an impact on the salary.

## Degree Means Most in Technical Jobs & Experience Means Most in Commercial Jobs

Generally, we would think that if someone has a higher degree or a longer working life, the person would be more likely to have a higher salary(that’s why we study hard and work hard, right?). However, the increase of one’s paycheck varies by job types and industries. For some kinds of jobs, your wage rises sharply as your working year increases, while some jobs have a different salary increase system weighting more on other factors. Similarly, some jobs attach great importance to worker’s education background but others don’t. To figure out the relationship between salary and degree or working experience in different jobs, we decide to use single factor regression for our analysis.

Single factor regression means that if you want to study the relationship between Y and X. You try to create a linear equation like Y = k*X + b. If k is larger, we can know that as X increases, Y would increases more and faster.

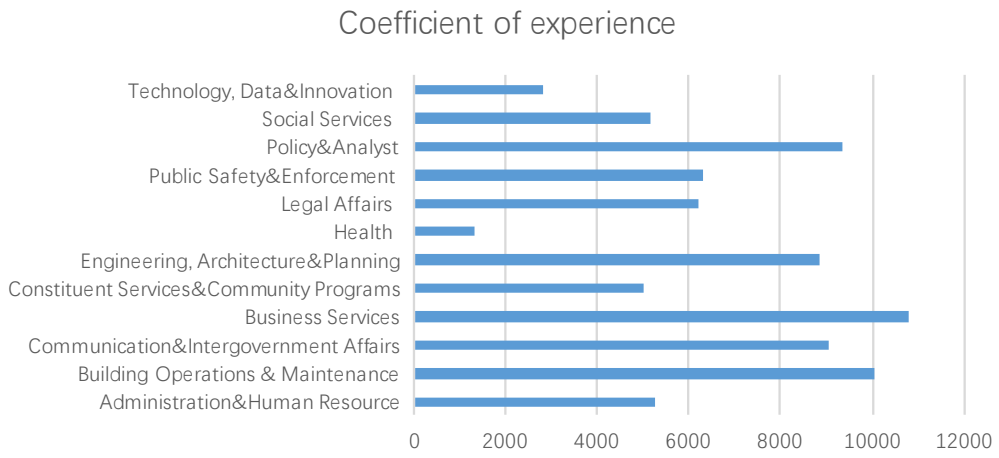
Firstly, we want to examine the influence of degree. We group all the jobs by their types, and in every job type, we regress salary on degree. Then we rank the influence (indicated by the coefficient) of degree by job category. Finally we find that technology, data & innovation jobs have the highest coefficient of degree:



We can see from the graph that the coefficient of the degree is 20135, which means that averagely, the gap of salary between different degreed workers is 20135 dollars. In other words, if you are a Management Science & Engineering master student and your friend just get his bachelor degree, and both of you decide to do some tech work in 2018, you are likely to get $20135 more than him in the end of year!

From the graph, we can also observe that the top 3 categories where the salary rise is influenced by degree mostly are: Technology, Data & Innovation, Public Safety & Enforcement and Health. That is to say, in these three categories, if you attain a high degree, your salary would be very likely to increase by approximately $20000 per year.

Similarly, we run a single factor regression on experience, list all the coefficients of experience in different job categories and make a ranking table:



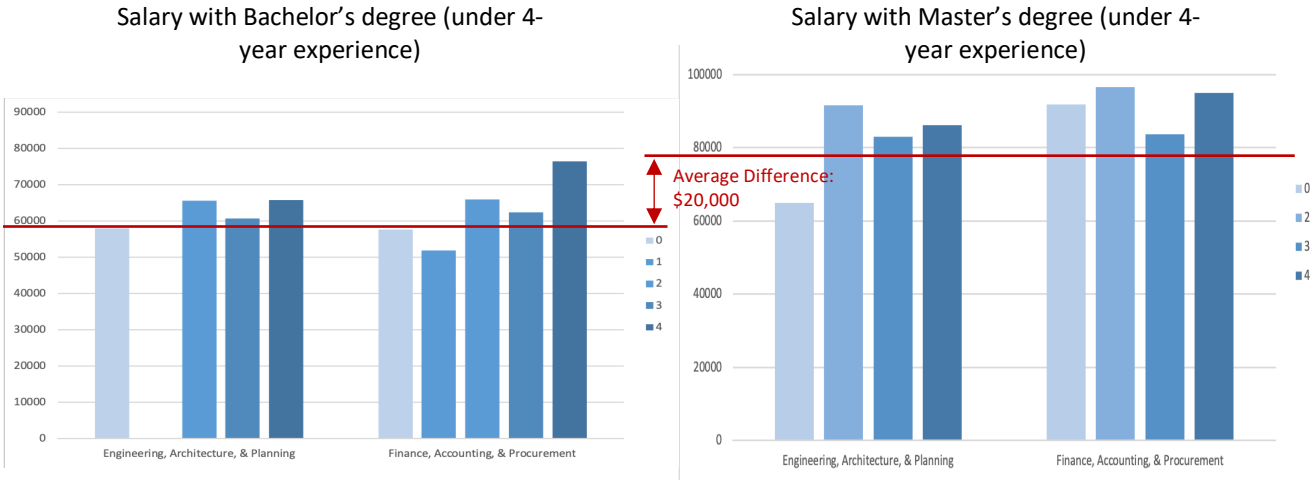

From the graph, we can see that Business services has a highest coefficient of experience. The coefficient of experience is 10042.1, which means if your working experience increases by 1 year, averagely your salary will go up by 10042 dollars.

Other job categories such as Building Operations & maintenance and Policy & Analyst also have a very high coefficient of experience in the regression. The result implies that if you want to have a job in such types, maybe you should previously work in other jobs for several years and then switch to it, so that you could get a much higher reward than directly enter the industry. Also, it also tells us that if you are a new worker with little working experience, you don't have to worry too much about your payback because it would increase rapidly as you work longer.

## Master Degree Might Not Be A Smart Investment for Entering NYC Government

From a student's perspective, after graduating from undergraduate school, a big concern is that should I continue studying for a higher degree like Master or should I start working immediately. Here, we gives a degree comparison analysis based on NYC social salary data, for those who intend to work for NYC government after graduation.

As shown before from the comparison of salary across different job categories, we learned that an extra degree can gain about $20,000 more amount of salary for the entry-level jobs at NYC government. So we assume that an employee with bachelor's degree and no working experience shall get an entry-level salary of $60,000, while similarly, an employee with master's degree and no working experience shall get $80,000 at the beginning (as indicated by the chart below). In this case, you might think that master is indeed more valuable than bachelor.




However, we must also consider the cost of gaining a master's degree. Besides the tuition charged by graduation school as around $50,000 per year, there's an opportunity cost that someone would get from working as a bachelor graduate, which is in this case, $60,000 for the first year. Since we learned from the previous section that salary level will increase when working experience increases, I get an average increasing speed for bachelor-degree employee and master-degree employee from the data we have separately. For master's degree, the salary increasing speed is $3,000 per year, while surprisingly, this increasing amount per year for bachelor is actually $5,000, which is significantly higher than master's degree. This may due to the fact that those jobs that only require bachelor's degree would weight higher on experience, while more technical jobs that require higher degree level might not see experience that important. Therefore, the salary amount across different experience level is more reluctant for master's than bachelor's degree.

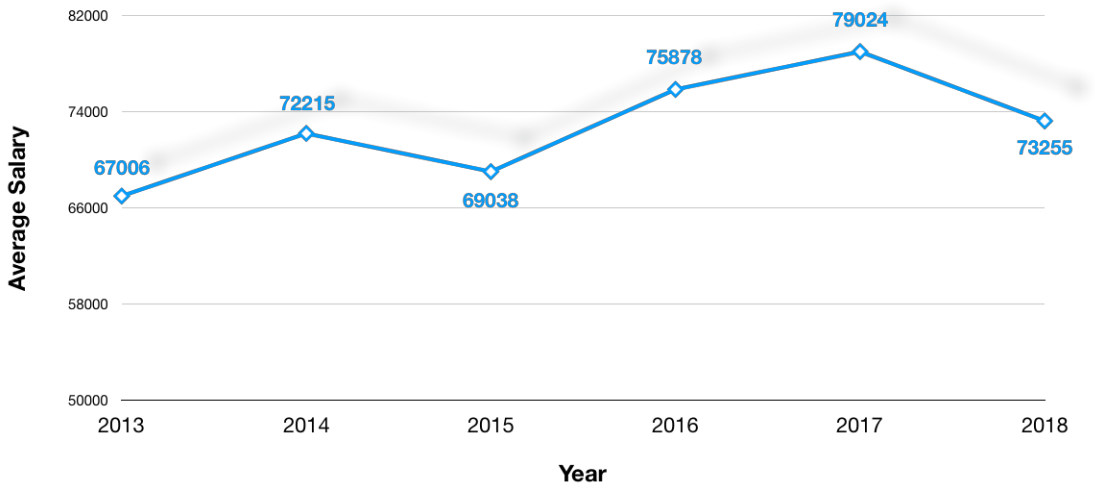
As seen below is the salary growth path comparison we did for the two different degree levels. We start counting when graduating from college for bachelor's degree. After comprehensive analysis considering both benefit and cost of earning a master's degree, we found that even after working for 6 years with master's degree, he/she still have a cumulative $195,000 amount of difference behind the one who begin work 2 years before with a bachelor's degree.

| | 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 | … |

Thus, we conclude that master's degree might not be a smart investment for people who hopes to work for governments, for its high tuitions and lower increasing salary growth rate.

## More Experience Helps Reduce Loss when Experiencing Government Budget Shrinkage

We plot the average annual salary with timeline and find that there is a pay cut in 2018 comparing to the increasing trend from 2015 to 2017.




In this case, an interesting question comes into our mind: which factor helps reduce loss when experiencing government budget shrinkages? Higher degree or lower degree? To solve this problem, we assume that annual salary can be written as a linear combination of other variables and also of an interactive term between degree ($y_{master}$) and year ($y_{2018}$) to have a better view of the inhibitive or promotive role played by academic qualifications on wage reduction in 2018. Here, the value of $y_{master}$ is 1 when the minimum requirement for a job is above Master's degree and is 0 below Master's degree; the value of $y_{2018}$ is 1 when a job is posted after 2018 and is 0 before 2018. The interactive term is thus $y_{2018} \times y_{master}$. In this case, $y_{2018} \times y_{master} = 1$ only happens when a job is posted after 2018 and its minimum requirement is above Master's degree. Since the average of salary in 2018 decreases, a higher degree helps reduce loss if $y_{2018} \times y_{master}$ has a positive contribution to annual salary.

As a result, it is proved in our model test that people with a Master's degree or above are less affected by government's budget shrinkages. Besides degree impact, we do the same model test on working experience and find it a more important factor than degree. People with longer working experience and higher academic qualifications are more likely to endure market fluctuations.

## Conclusions & Recommendation for Job Seekers

1. For those students aiming for working in NYC government, we recommend that you focus more on accumulating your working experience, and you are more likely to endure market fluctuations with longer working experiences.

2. In New York City, working for government is a better choice for undergraduate or high school students. 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.

3. If you want to apply for jobs in types of business services, building operation & maintenance or policy & analyst, you would benefit more by having more working experiences.

4. For master students, 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.

Data source: https://data.cityofnewyork.us/City-Government/NYC-Jobs/kpav-sd4t