Introduction

For many years, National University of Singapore (NUS) and Nanyang Technological University (NTU) are the only two autonomous universities in Singapore, until more autonomous universities are set up, such as the Singapore Management University (SMU) in year 2000 and both Singapore Institute of Technology (SIT) and Singapore University of Technology (SUTD) in year 2009.

In comparison, NUS, NTU and SMU remains the more reputable universities due to their rankings, history and period of establishment. Therefore, in general, more students from graduating Junior College (JC) or polytechnic cohort prefer to apply for the reputable universities if possible.

Objective

The purpose of the study is to find out if the salary of the fresh graduate from the newer local universities such as SIT and SUTD are comparable to the more reputable universities such as NUS, NTU and SMU. Based on the university rankings and admission criteria, there is a general perception that the more reputable universities such as NUS, NTU or SMU can provide employment terms for better salary and career head start. In order to identify if the salaries across the five universities are comparable, the mean salary of the fresh graduate will be explored.

Factors affecting starting salary includes the type of school (example: STEM, Arts and Humanities etc.) and type of degree of a graduate. In this report, to account for the average salaries of each university, all different type of school and degree are included.

Research Question

The research question is "Is there a difference between the mean salary of fresh graduate from NTU, NUS, SIT, SMU and SUTD"? If there is no difference, the total average salary of the fresh graduates across the five universities will be used as the benchmark. Other factors such as employment rate and duration taken to be employed are also useful for comparison but will not be covered.

Data Planning and Collection

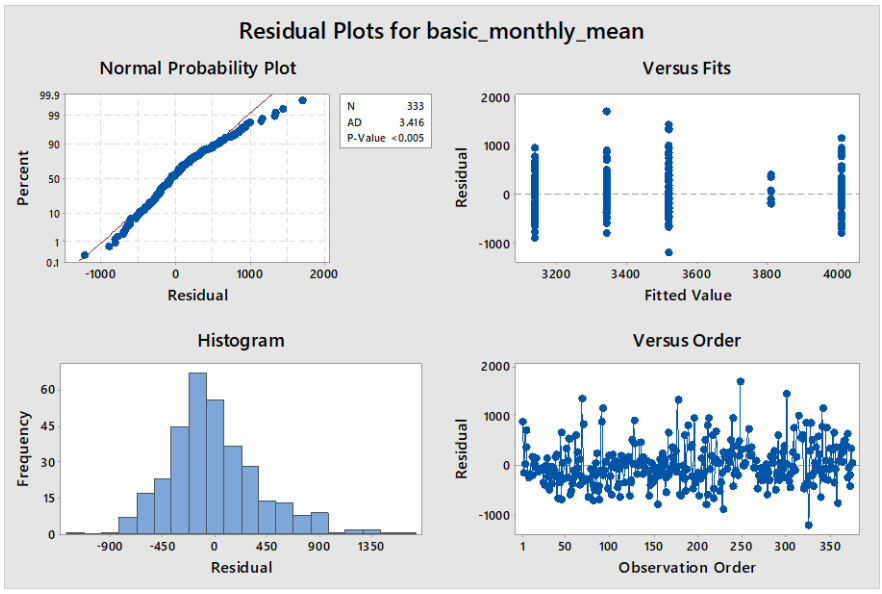
Data collected	Singapore government database, from data.gov.sg
Sample Data	Graduate employment survey respondents (6 months after graduation) from the five universities between 2015 to 2017
Population	Fresh graduate employed after six months from the five universities every year
Sampling Method	Cluster Sampling. Based on the population, the cluster selected are fresh graduate from the universities between the year of 2015 to 2017
Sample Size	Between 290 to 6050 from each university yearly from 2015 to 2017
Types of Data	1) Mean salary - Quantitative, 2) University - Qualitative (Nominal)

Data Analysis

The level of significance will be 0.01. Response: Mean Salary, Factor: University, Levels: 5 levels (the different universities).

Check for normality

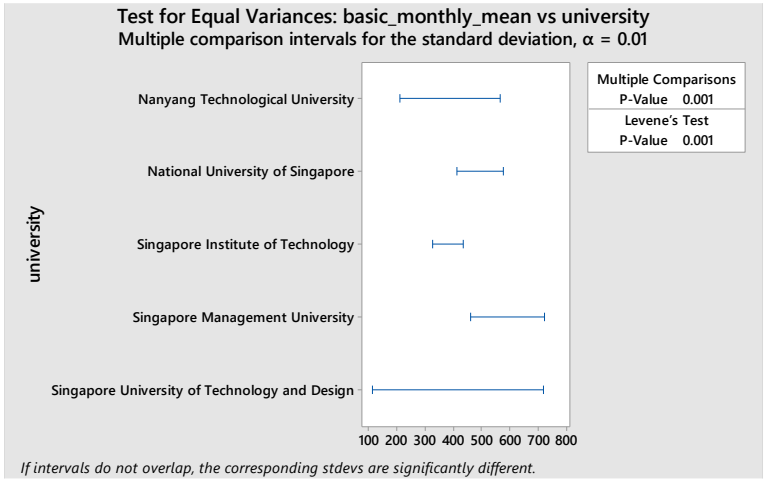
Assumption for ANOVA:



1) Residuals follow a normal distribution – From the normal probability plot, the P-Value is <0.005 and the right-skewed data formed a slightly curved line, with most of its residuals following a straight line.

2) Each sample is independence – From the observation order plot, there are no trend, shift or cycle identified and therefore, residuals are random and independence.

3) Equal variance (or standard deviations) – Using Leven's Test, P-value is 0.001, which is < than 0.1. Hence, the variances are unequal and assumption 3) is not met.



Since assumption 3) is not met, we will use Welch's ANOVA instead of Fisher's One-way ANOVA. Welch's ANOVA result will be unaffected by the unequal variance while using Fisher's One-way ANOVA will produce a result more inaccurate.

Numerical and Graphical summary

One-way ANOVA: basic_monthly_mean versus university

Method

Factor Information

Null hypothesis	All means are equal
Alternative hypothesis	Not all means are equal
Significance level	α = 0.01
Rows unused	43

Equal variances were not assumed for the analysis.

Welch's Test

Source	DF Num	DF Den	F-Value	P-Value
university	4	53.8423	29.37	0.000

Model Summary

R-sq	R-sq(adj)	R-sq(pred)
27.37%	26.48%	25.23%

Factor	Levels	Values
university	5	Nanyang Technological University, National University of Singapore, Singapore Institute of Technology, Singapore Management University, Singapore University of Technology and Design

Means

university	N	Mean	StDev	99% CI
Nanyang Technological University	102	3339.7	339.5	(3251.5, 3428.0)
National University of Singapore	107	3517.7	481.7	(3395.6, 3639.9)
Singapore Institute of Technology	79	3136.4	370.1	(3026.5, 3246.3)
Singapore Management University	36	4010.4	553.2	(3759.2, 4261.5)
Singapore University of Technology and Design	9	3808.2	230.0	(3551.0, 4065.4)

Hypothesis Testing and Interpretation

From the above, we can see that the P-Value = 0.000, F-Value = 29.37 > F-Critical = 3.76 (df = 4, 328). Since the P-value is < 0.01 (and F-test is in the rejection region), we will reject H_0 and conclude that the mean salary of fresh graduate from the five different universities differs. Also, the Coefficient of Determination indicates that 27.37% of the variation in the mean salary of fresh graduates can be explained by the university they studied.

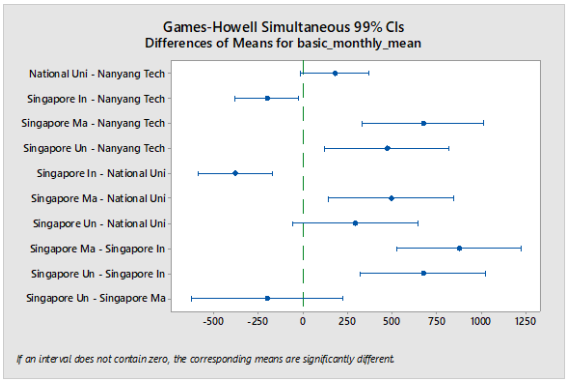
Multiple Comparison Test

Games-Howell Pairwise Comparisons

Grouping Information Using the Games-Howell Method and 99% Confidence

University	N	Mean	Grouping		
Singapore Management University	36	4010.4	A		
Singapore University of Technology and Design	9	3808.2	A	B	
National University of Singapore	107	3517.7		B	C
Nanyang Technological University	102	3339.7			C
Singapore Institute of Technology	79	3136.4			D

Means that do not share a letter are significantly different.



Grouping	Universities	**Results Interpretation**
A	SMU and SUTD	**Mean of both universities are not significantly different**
B	NUS and SUTD	**Mean of both universities are not significantly different**
C	NUS and NTU	**Mean of both universities are not significantly different**
D	SIT	**Mean is significantly different from other four universities**

Games-Howell Simultaneous Tests for Differences of Means

Difference of Levels	Difference of Means	SE of Difference	99% CI	T-Value	Adjusted P-Value	**Results Interpretation**
NUS - NTU	178.0	57.4	(-11.6, 367.7)	3.10	0.019	**P-Value within 99% CI, Means are not significantly different**
SIT - NTU	-203.3	53.5	(-380.4, -26.2)	-3.80	0.002	**P-Value not within 99% CI, Means are significantly different**
SMU - NTU	670.7	98.1	(330.6, 1010.7)	6.83	0.000	**P-Value not within 99% CI, Means are significantly different**

SUTD - NTU	468.5	83.7	(118.1, 818.9)	5.60	0.001	**P-Value not within 99% CI, Means are significantly different**
SIT - NUS	-381.3	62.5	(-587.6, -175.0)	-6.10	0.000	**P-Value not within 99% CI, Means are significantly different**
SMU - NUS	493	103	(139, 846)	4.77	0.000	**P-Value not within 99% CI, Means are significantly different**
SUTD - NUS	290.5	89.7	(-62.8, 643.8)	3.24	0.038	**P-Value within 99% CI, Means are not significantly different**
SMU - SIT	874	101	(526, 1222)	8.64	0.000	**P-Value not within 99% CI, Means are significantly different**
SUTD - SIT	671.8	87.2	(320.2, 1023.4)	7.70	0.000	**P-Value not within 99% CI, Means are significantly different**
SUTD - SMU	-202	120	(-627, 223)	-1.69	0.456	**P-Value within 99% CI, Means are not significantly different**

Errors

Since we reject the null hypothesis, there is a possibility of Type I error "false positives", which means when the null hypothesis is true but is rejected. The test of 99% confidence interval means there is a 1% chance of having type I error.

Results Interpretation

The outcome of the hypothesis test shows that there is a difference in the mean salary of fresh graduate between the five universities. We can also see that the mean salary of the universities from the lowest to highest is in the order of SIT, NTU, NUS, SUTD and SMU. Based on the comparison test, we know that the mean salary of SUTD fresh graduates is comparable to the more reputable universities, SMU and NUS. However, the mean salary of SIT is not comparable to the other four universities. The higher average salary of SUTD is probably due to the school only having engineering graduates and low sample size. On the other hand, SMU includes Law and Accountancy graduates which increases the average salary, while NUS and NTU includes many fields of study, likely with the Arts and Humanities field lowering the average salary.

Conclusion

Since we have established that there is a difference in the average salary for the different universities, further studies can be made by comparing the average salary with the same school category or type of degree for the different universities, to more accurately reflect whether studying in the more reputable universities earns more. Also, further studies on the employment rate, duration taken to be employed and employment position of the fresh graduate can determine if studying in the more reputable universities truly holds an advantage.

Reference

https://data.gov.sg/dataset/graduate-employment-survey-ntu-nus-sit-smu-sutd

https://statisticsbyjim.com/anova/welchs-anova-compared-to-classic-one-way-anova/