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Research Topic

iOS and Android stand as the world's most widely adopted mobile operating systems. Annually, Apple, known for designing its proprietary processors, and other companies employing third-party processors, strive to launch smartphones boasting enhanced processing capabilities. My research aims to conduct a statistical analysis to determine which category of phones has consistently exhibited superior processing power, up until the year 2020 on the basis of different metrics.

Collection of Data

To facilitate the comparison of outcomes, I employed benchmark testing results, a practice within computing that involves running various sets of programs or operations to evaluate the relative performance of a hardware component. This evaluation is typically conducted through a series of standardized tests and trials.

To collect my data, I utilized AnTuTu as the benchmark testing software. AnTuTu comprehensively assesses and provides individual scores for crucial components, including the CPU (Central Processing Unit), GPU (Graphics Processing Unit), memory read and write speeds, and overall User Experience.

Given that Apple annually releases only one phone model, which needs to be juxtaposed with numerous smartphone models from various companies operating on the Android OS, I opted to focus on the flagship phone from each year for my comparative analysis. A flagship phone represents the pinnacle of a company's offerings in a given year.

Link for the AnTuTu website - https://www.antutu.com/en/ranking/rank1.htm

SAS Code

```
PROC FORMAT;
VALUE $OperatingSystem 'i' = 'iOS'
                       'a' = 'Android';
DATA SmartPhones;
INPUT OS $ CPU GPU MEM UX @@;
TOTAL = CPU + GPU + MEM + UX;
LABEL OS = 'Operating System'
CPU = 'Central Processing Unit'
GPU = 'Graphics Processing Unit'
MEM = 'Memory Read and Write Speed'
UX = 'User Experience';
FORMAT OS $OperatingSystem.;
```

```
DATALINES;
i 185231 212608 79051 77794  i 184836 211444 78607 77648  i 178583 205162 93189 76594
i 182729 200879 77309 83158  i 149208 181893 60863 82904  i 148221 183314 67626 80510
i 140194 155143 64538 78035  i 144646 159390 71430 70142  a 182017 250099 101961 86752
a 184311 239240 99442 83003  a 177641 236910 99018 88218  a 180174 228891 90462 84696
a 155478 216687 71887 75913  a 152928 194070 71075 74377  a 144732 197747 80356 68944
a 153117 186754 59208 64104
;

PROC PRINT DATA = SmartPhones;
RUN;
```

Obs	OS	CPU	GPU	MEM	UX	TOTAL
1	iOS	185231	212608	79051	77794	554684
2	iOS	184836	211444	78607	77648	552535
3	iOS	178583	205162	93189	76594	553528
4	iOS	182729	200879	77309	83158	544075
5	iOS	149208	181893	60863	82904	474868
6	iOS	148221	183314	67626	80510	479671
7	iOS	140194	155143	64538	78035	437910
8	iOS	144646	159390	71430	70142	445608
9	Android	182017	250099	101961	86752	620829
10	Android	184311	239240	99442	83003	605996
11	Android	177641	236910	99018	88218	601787
12	Android	180174	228891	90462	84696	584223
13	Android	155478	216687	71887	75913	519965
14	Android	152928	194070	71075	74377	492450
15	Android	144732	197747	80356	68944	491779
16	Android	153117	186754	59208	64104	463183

```
/* I decided to do a one way ANOVA on the dataset*/

PROC ANOVA DATA = SmartPhones;
CLASS OS;
MODEL CPU GPU MEM UX TOTAL = OS;
MEANS OS / SNK;
RUN;
```

The ANOVA Procedure

Dependent Variable: CPU Central Processing Unit

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	17535156	17535156	0.05	0.8222
Error	14	4684499704	334607122		
Corrected Total	15	4702034860			

R-Square	Coeff Var	Root MSE	CPU Mean
0.003729	11.06926	18292.27	165252.9

Source	DF	Anova SS	Mean Square	F Value	Pr > F
OS	1	17535156.25	17535156.25	0.05	0.8222

The ANOVA Procedure

Dependent Variable: MEM Memory Read and Write Speed

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	407999601	407999601	2.28	0.1533
Error	14	2505005157	178928940		
Corrected Total	15	2913004758			

R-Square	Coeff Var	Root MSE	MEM Mean
0.140061	16.90515	13376.43	79126.38

Source	DF	Anova SS	Mean Square	F Value	Pr > F
OS	1	407999601.0	407999601.0	2.28	0.1533

The ANOVA Procedure

Dependent Variable: UX User Experience

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	37830.3	37830.3	0.00	0.9778
Error	14	662836913.8	47345493.8		
Corrected Total	15	662874744.0			

R-Square	Coeff Var	Root MSE	UX Mean
0.000057	8.787803	6880.806	78299.50

Source	DF	Anova SS	Mean Square	F Value	Pr > F
OS	1	37830.25000	37830.25000	0.00	0.9778

The ANOVA Procedure

Dependent Variable: GPU Graphics Processing Unit

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	3616969952	3616969952	6.77	0.0209
Error	14	7482127268	534437662		
Corrected Total	15	11099097220			

R-Square	Coeff Var	Root MSE	GPU Mean
0.325880	11.34541	23117.91	203764.4

Source	DF	Anova SS	Mean Square	F Value	Pr > F
OS	1	3616969952	3616969952	6.77	0.0209

The ANOVA Procedure

Dependent Variable: TOTAL

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	7112097056	7112097056	2.20	0.1603
Error	14	45284276631	3234591188		
Corrected Total	15	52396373686			

R-Square	Coeff Var	Root MSE	TOTAL Mean
0.135736	10.80334	56873.47	526443.2

Source	DF	Anova SS	Mean Square	F Value	Pr > F
OS	1	7112097056	7112097056	2.20	0.1603

From the pictures of the output on doing the one way ANOVA procedure we find that there is no statistically significant difference between the two operating system in the field of CPU, Memory read and write speed, user experience and total score (since p value is greater than 0.05) however, there is a significant difference in terms of GPU of the two phones (since p value 0.0209<0.05).

To test which phones GPU is better I did an SNK test on the independent variable.

In case of GPUs, the performance of Android phones is much better.

The ANOVA Procedure

Student-Newman-Keuls Test for GPU

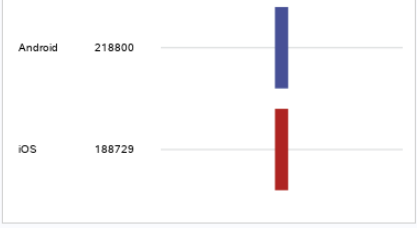
Note: This test controls the Type I experimentwise error rate under the complete null hypothesis but not under partial null hypotheses.

Alpha	0.05
Error Degrees of Freedom	14
Error Mean Square	5.3444E8

Number of Means	2
Critical Range	24791.491

GPU SNK Grouping for Means of OS (Alpha = 0.05)

Means covered by the same bar are not significantly different.



Results

In the analysis of CPU, Memory, User Experience, and the total score, the obtained p-values exceeded 0.05. Consequently, I failed to reject the null hypothesis, suggesting that their performance was relatively similar. However, in the case of the GPU (Graphics Processing Unit), a p-value of 0.0209 was obtained, leading to the rejection of the null hypothesis.

Subsequent post hoc SNK testing revealed that Android phones outperformed iPhones in terms of GPU performance. This implies that Android phones are better suited for gaming due to their superior GPU capabilities. In summary, the statistical analysis indicates that the overall performance of the two smartphone categories is fairly similar when considering the total score. Nevertheless, Android phones outshine iPhones in the realm of gaming due to their enhanced GPU performance.