1. **The expression levels of the four markers are measured for each treatment arm. For those markers which are not significant (pre treatment), calculate the number of samples required to have 80% power to detect a statistically significant difference (remember we have performed 4 tests here).**

* From assignment 1 we know the markers that were not significant were: CX3CL1, TNFA and CCL20. The results are listed in the table below and followed by the code.

|  |  |  |  |
| --- | --- | --- | --- |
|  | CX3CL1 | TNFA | CCL20 |
| Cohen’s d | -0.3758389 | -0.251839 | -0.2623667 |
| N of samples(per group) | 113 | 249 | 229 |

* To begin I calculated the effect size of the sample group using Cohen’s d, it is essentially the difference between the means. This will tell us how different the two groups are. We also need this for the power test as we need three of the known variables to calculate the fourth. We have the desired significance level, power and now will have the effect size to calculate the number of samples per arm needed.
* By having the correct number of samples in the treatments arms it will increase the possibility of finding a true difference between the two groups. Small groups can hide true results as large differences are needed to be detected as significant.
* Text

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* The effect size is small so we are likely to need more samples to detect if there is a statistically significant group. We use the t test power calculation to tell us how many samples are needed.
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* N tells us how many samples per group we need in order to detect a statically significant difference between the groups.
* This was repeated for the two other groups that were determined not to be significant results are seen in the table above.

1. **Each of the 4 immune cell markers represent different parts of the immune system. Are these markers effected differently by the anti-HER2 treatments (the post treatment cohort)? Look at trastuzumab and lapatinib separately. Where there is no significant difference calculate the number of samples required to have 80% power to detect a statistically significant difference.**

* To start I separated the data into values of pre and post expression levels for each treatment arm. I then conducted a hypothesis test, using the Shapiro test, to determine the distribution of the data. If normally distributed the students t test was used, if not the Wilcoxon test was used.
* Text

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* The non-significant results(p>0.05 in the Wilcoxon test for significant difference of the median of the ranks) were: TNFA in the Lapatinib arm and CX3CL1 Trastuzumab arm.
* The wilcox test was paired because it is before and after the treatment.
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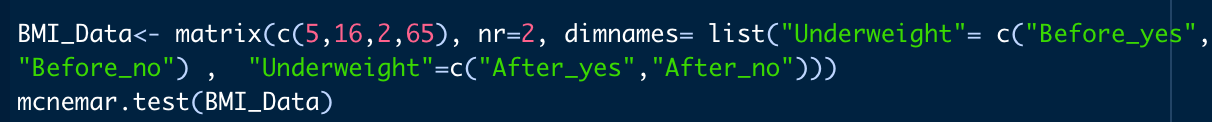
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|  |  |
| --- | --- |
| TNFA Lapatinib | CX3CL1 Trastuzumab |
| 0.533579 | -0.04845259 |
| Graphical user interface, application  Description automatically generated | Graphical user interface, text, application  Description automatically generated |
| Graphical user interface, text, application  Description automatically generated | Graphical user interface, application  Description automatically generated |
| 57 per arm | 1. per arm |

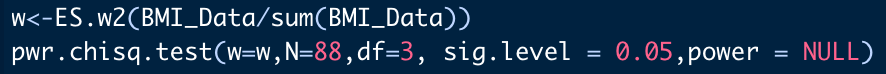
1. **As mentioned in assignment 2, this particular treatment regimen is quite severe (the backbone is paclitaxel and cisplatin). Loss of appetite, gastrointestinal upset and weight loss are common side effects. The treating clinician will intervene to mitigate this. However, in some cases a severe nutritional deficit will occur. Is there a significant increase in the number of underweight patients in the two treatment arms post treatment (classed as a BMI of < 20, “BMI\_post\_treatmetn”)? If not, how many samples would be needed to have an 80% power to detect a significant difference?**

* To test if there was a statistical difference in underweight BMI before and after treatment I ran a count to identify the number of underweight BMI pre and post treatment.
* Text

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* Using this data I created a matrix to test for significance using a mc nemar test because the groups are related i.e. before and after the intervention.
* 
* This gives us this table:
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* There is a significant p value (<0.05) which means there is a significant difference in the number of underweight patients pre and post treatment.
* This value is significant but to what power?
* 
* Using the power test for a chi square this test and subbing in the number of samples in the data it is powered to:0.74
* To get 80% power I subbed removed the N and let power=0.8.
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* We would need to increase the sample size to 102 participants to get 80% power with a significance level of 0.05.

1. **23% of the Irish adult population is obese versus ~31% of samples in this dataset (classed as a BMI of >30, “BMI\_pre\_treatment”). How large would the study need to be to have an 80% power to detect a significant difference between HER-positive breast cancer patients and the Irish population as a whole?**

* First we will calculate the effect size.
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* This will be used to sub into the equation to detect the power between two proportions i.e. sample population and general population.
* Graphical user interface

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* This tells us that we would need 482 participants per arm in order to detect a significant difference.
* It is common to have different numbers in the sample sizes. Often the ‘disease’ sample is a lot smaller than the population sample. We can test the number of participants we would need if, for example, we had a population sample of 1000.
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* If we had a population size of 1000 to represent the population we would only need 318 participants in the disease arm to detect a statistically significant difference.