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BAC: Theory & Practice

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At one of the parties which I hosted recently, the following experiment was conducted.

Several people agreed to perform periodically a breath test for their Blood Alcohol Concentration [BAC]. The Alcohawk Precision device has been used for measurements with announced precision of 0.008% at 0.1% level [1]. Their results have been recorded, along with the time of the test and the data on what they have been drinking before.

After the experiment, the values of **predicted** BAC level for them have been calculated based on the Widmark formula [2], corrected for alcohol breakdown effect (based on numerous sources like [3, 4]). This model is referred further as the Standard Model [see the Appendix A]. Then, theoretically calculated Blood Alcohol Concentration was compared with experimentally measured values for the purpose of validating the prediction mechanism.

The following 4 charts represent the results for people with at least 3 tests taken:

Person 1
Person 2
Person 3
Person 4

Results discussion:

The dispersion of predictability is very high. The Standard Model gave quite reliable prediction for Person 1, somewhat coherent results for Persons 2 and 3, and was way off the experiment with Person 4. However, for **all** experiments predicted levels of BAC were on par or significantly higher than the actual ones.

Possible explanations of that include: a) experimental errors (e.g., incorrectly reported number of drinks); the impact of food ("закуска"); c) variations of individual tolerance to alcohol. The latter is partly supported by [3] mentioning that one's alcohol metabolism may be genetically determined.

The only reliable conclusion we can make based on that is that the impact of alcohol on an individual is very complex phenomena, hardly predictable based on a simple approach like Widmark formula.

Appendix A.

Standard Model gives the following prediction for human's BAC:

BAC[%] = 0.1*A/(W*k) - f*T, where

A -- is the amount of alcohol consumed in grams. To obtain it, multiple the volume of your drink by volume content ["градусы"], and then by alcohol density which is 0.8 g/cm^3

W -- this is your body weight in kilograms

k -- the coefficient which is 0.7 for men, 0.55 for women, and about 0.75 for children.

f -- the speed of alcohol dissipation from your blood. At the state of physical alertness [e.g., daytime] it's is about 0.015% per hour; when you sleep, especially at midnight, it can drop to about 0.009% per hour. That speed is quite constant and is defined by your liver capability to break down the alcohol.

T -- the time since the first drink, hours.

A variation of the formula above is used by the US Department of Transportation to give us an estimate of how many drinks are safe for driving [4].

That formula is supposed to work for BAC greater than ~0.01% and periods of times greater

than at least ~0.5 hours since the first drink.

However, please don't rely upon any of the information above on whether it is safe to drive or not. I will not accept any responsibility for consequences of using [or not using] that information. The only safety advise applicable is:

DO NOT DRINK AND DRIVE!

Even with 0.01% BAC, you may be impared and thus have higher chances to get into the accident, etc.

Appendix B. Some extra reference materials:

B1. A Web site with a list of unusual driving signs and their interpretation by the police in terms of their estimation of driver's probability being drunk:
http://www.duinetwork.com/dui/maryland/getxmldoc/content/blood_alcohol_tests.html

B2. Specific effects of alcohol as function of its' blood concentration:
http://www.indiana.edu/~adic/effects.html

B3. In Washington, the maximum potentially tolarable limit of BAC for driving a car is 0.08%.

Aknowledgements

Author is very thankful to all participants for having a great time on the party and helping to conduct the experiment. For obvious reasons, the names of the participants are not going to be disclosed unless they explicitly ask me to do so.

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