

Climate Change Calculated, Corona Update 3

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Today:

- **We compute the Under Detection Rate**
- **Online Corona Programs for computing the under detection rate, and a 30 day prediction**

If you are interested, stay tuned

- The Corona virus spreads through **aerosols** that can stay in the air for hours.
- Keeping your distance and wearing masks **reduce the concentration** of the viruses and thus reduce the likelihood of an infection.
- The virus attacks the **blood vessels**, which hinders or blocks blood flow, which can also cause permanent damage.

- The **average age** of those infected has dropped significantly, from 52 to 36 years:
<https://www.mdr.de/sachsen-anhalt/corona-daten-upd-ate-coronavirus-infierter-haben-immer-juenger-covid-neunzehn-100.html>
- This is probably because younger people meet more often in larger groups without mask and distance, while the older ones pay more attention to distance and mask wearing.
- Since younger people have a lower mortality risk, this also reduces the overall infection mortality risk. See also:
<https://www.nature.com/articles/d41586-020-02483-2>

Problem: with tests we can only detect a certain fraction of all infected

- Test have **false positives** and **false negatives**
- Tested are usually only persons returning from at **risk countries**, or with **clear symptoms**

- The **percentage of positive tests** in Germany in September is **0.97% -1.2%**
(<https://de.statista.com/infografik/22496/nummer-der-gesamten-positiven-corona-tests-und-positivenrate>)
- **Test accuracies:**
<https://www.finddx.org/covid-19/sarscov2-eval-molecular/molecular-eval-results/>
- **False positives:**
(1 - “specificity”): **approx. 2%** (factor 0.02), in the same order of magnitude as the percentage of positive tests.
Therefore **at least 2 tests are done, e.g. with 2 genes.**
- **“Dual target” tests:** Two gene regions are tested, which is like 2 tests in parallel:
https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Vorl_Testung_nCoV.html

- With 2 independent tests, the probability that the first test is false positive ***and*** the second test is false positive is the **product of the probability** that a single test has a false positive.
- This is a “**compound probability**” (see also: <https://study.com/academy/lesson/compound-probability-definition-examples.html>)
- Hence we get:
 $0.02 * 0.02 = 0.0004 = \mathbf{0.04\%}$,
- This is indeed significantly lower than the percentage of positive tests. Hence we get a **very accurate detection**.
- There are also **false negatives** (1 - “sensitivity”): **approx. 4%**. If there is suspicion, the **test is also repeated**.
- See the test strategy: https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Teststrategie/Nat-Teststrat.html
 “Bei weiterhin bestehendem, begründetem Krankheitsverdacht kann ein negatives PCR-Testergebnis ggf. durch einen zweiten Test bestätigt werden.”

But more important than false positive or false negative rates are those **infected who have not been tested**.

- Q: How can we estimate the **true number** of Corona infected?
- A: Using the “**Under Detection Rate**”.

- **How can we compute it?**
All who are tested positive for the Corona virus (detected) either recover (they are called “recovered” even if there is permanent health damage), or they die.
- Hence the sum of the dead and recovered equals the number of detected before.

- This leads to the “**case fatality rate**”
- $case\ fatality\ rate = \frac{number\ of\ dead}{number\ of\ dead + number\ of\ recovered}$
- Where
(number of dead + number of recovered) = (number of positive tested before).
- For the definitions also see:
https://en.wikipedia.org/wiki/Case_fatality_rate)

- The percentage of the *infected* who die is lower.
This leads to the “**infection fatality rate**”

- $infection\ fatality\ rate = \frac{number\ of\ dead}{number\ of\ infected}$

- It is estimated in controlled environments, like a cruise ship or small towns, where everybody can be tested.
- Hence we obtain the underdetection rate as

$$underdetection\ rate = \frac{case\ fatality\ rate}{infection\ fatality\ rate} = \frac{number\ of\ infected}{number\ of\ positive\ tested}$$

- Hence the **under detection rate** is the **ratio of “Case fatality rate” to “Infection fatality rate”**.
- The estimation of the infection based fatality rate varies (usually 0.6% to 5%), and is assumed to be 2% here (see my Corona Update Video).
- A calculation of the underdetection rate can be found in my “Corona special” video, mid-March, (Link: <https://youtu.be/2UnOiSV-e2o>):
- Case fatality rate: 0.07 (= 7%), Infection fatality rate: 2%,
- **Underdetection rate = 7% / 2% = 3.5**

- And in “Corona Update” in mid-April, (<https://youtu.be/23LajKrdhxM>):
- Case fatality rate: 4.6%, Infection fatality rate: 2%,
- **Underdetection rate: $4.6\% / 2\% = 2.3$**

- More recent studies have measured the under detection rate, see: https://www.rki.de/DE/Content/Gesundheitsmonitoring/Studien/cml-studie/cml-studie_node.html

- On August 14th, 2020: https://www.rki.de/DE/Content/Gesundheitsmonitoring/Studien/cml-studie/Factsheet_Kupferzell.html
- **“Dunkelziffer”**: “Through the study **3.9** times more infections were detected than previously known in Kupferzell.”
- On August 25, 2020: https://www.rki.de/DE/Content/Gesundheitsmonitoring/Studien/cml-studie/Factsheet_Bad_Feilnbach.html
- **“Dunkelziffer”**: “The study detected **2.6** times more infections than previously known in Bad Feilnbach.”

- So that **fits very well** with my estimates of 3.5 and 2.3 in March and April!

- So the assumed 2% infection fatality rate seems to be **about right**, but is probably **going down** in Germany (with the reduced average age of infected).
- The actual observed Corona progression since March is essentially as in my optimistic scenario from March.
- There are noticeable deviations downwards due to **staying at home** from mid-March and then the introduction of the **mask and distance** requirement, which seem **highly effective**.

My Corona program in Python:

For plots of

- concurrently sick people per million inhabitants in different countries,
- an estimation of the true concurrently sick using the underdetection rate,
- and a 30 day forecast,
- Link:
<https://github.com/TUllmenauAMS/CoronaComputationPrograms>
- **Observe:** early September there are about **220** concurrently sick per million in **Germany**.

- For comparison: in the **US** there are over **11,000** concurrently sick per million inhabitants (without underdetection rate) at the beginning of September, **50 times** as many as in Germany!
- **Germany** has about **110 Corona deaths** per million inhabitants.
- The **US, Brasil, Italy** and **Spain** all have **over 600 deaths** per million inhabitants, about a **factor of 6 more!**

- Also observe that you can change the countries in the program, together with its populations, in million inhabitants.

Example:

Corona demonstration in Berlin: We currently have around 220 actively sick people (i.e. contagious people) per million inhabitants. With the underdetection rate of roughly 3 we actually have 660 actively sick people. Assuming 28,000 participants, there are approx. $28,000 * 660 / 1e6 = 18.5$ actively sick on the demonstration. If distance and

mask wearing are not adhered to, everyone infects about 2.7 more (reproduction number R_0 , see my Corona Update Video), i.e. $18.5 * 2.7 = 50.2$. They then go home and infect more in their surroundings, etc., as new growth cells. The more growth cells, the more difficult it is for the health authorities to track and isolate. That is the dangerous thing. Of these first 50 alone, around 2%, i.e. 1, will die, and around 15%, i.e. around 7.5, will have a severe course with permanent damage (see my Corona Special).

At other demonstrations in Berlin (there are several there every weekend) the measures are apparently adhered to, which is not difficult. For example, I always have a mask in my pocket.