Twitter Thread by Dr. Simon ■

Dr. Simon ■
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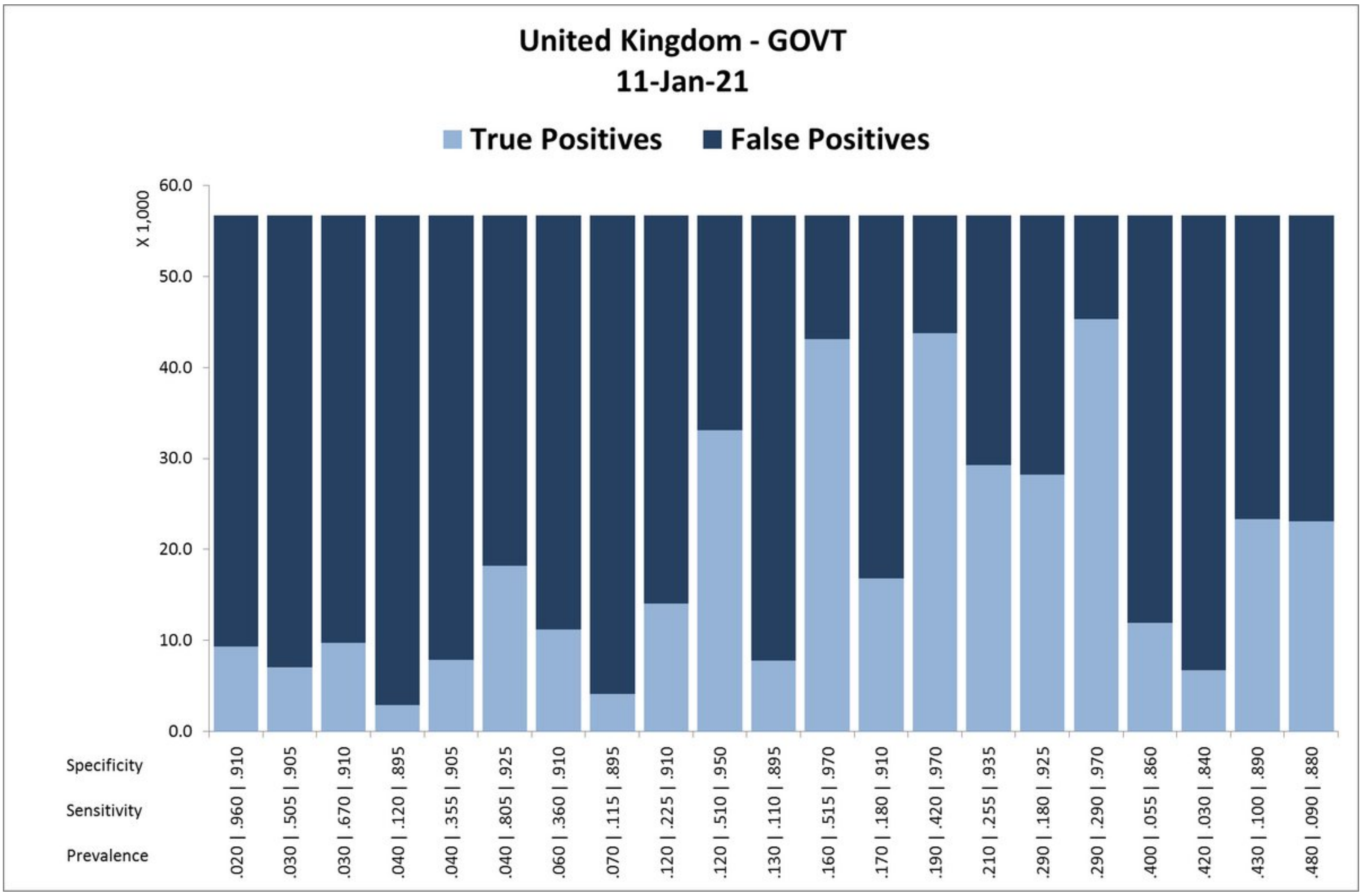
1/ Happy to announce that we have submitted our #paper ‘Bayes Lines Tool (BLT) - A SQL-script for analyzing diagnostic test results with an application to SARS-CoV-2-testing’.

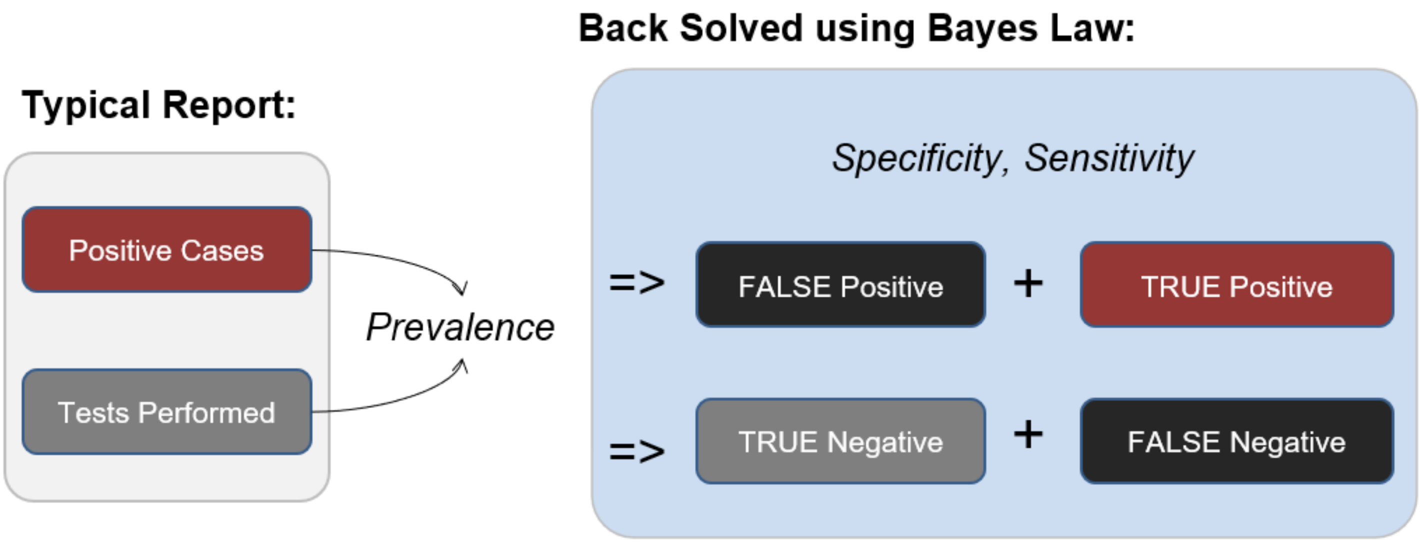
In this ■■thread■■, I will explain why our tool is that powerful for decision makers. #UnbiasedScience



2/ In the meantime, the submitted paper is available on the preprint platform @zenodo_org. Factual criticism is highly desired and encouraged. The publication itself presents a seminal Bayesian calculator, the Bayes Lines Tool (BLT). (Petje af, @waukema!) https://t.co/FEYvH3D0Gf

3/ The Bayes Line Tool (available on https://t.co/jIomSIxOd9) is able to back-solve disease #prevalence, test #sensitivity, test #specificity, and therefore, true positive, false positive, true negative and false negative numbers from official governmental test outcome reports.

4/ This is done by creating confusion matrices with four variables. Namely: TP, FP, TN, FN. In order to calculate the matrices, we need prevalence, specificity, and sensitivity as well as the number of people that got tested (within a given period) and the number of positives.

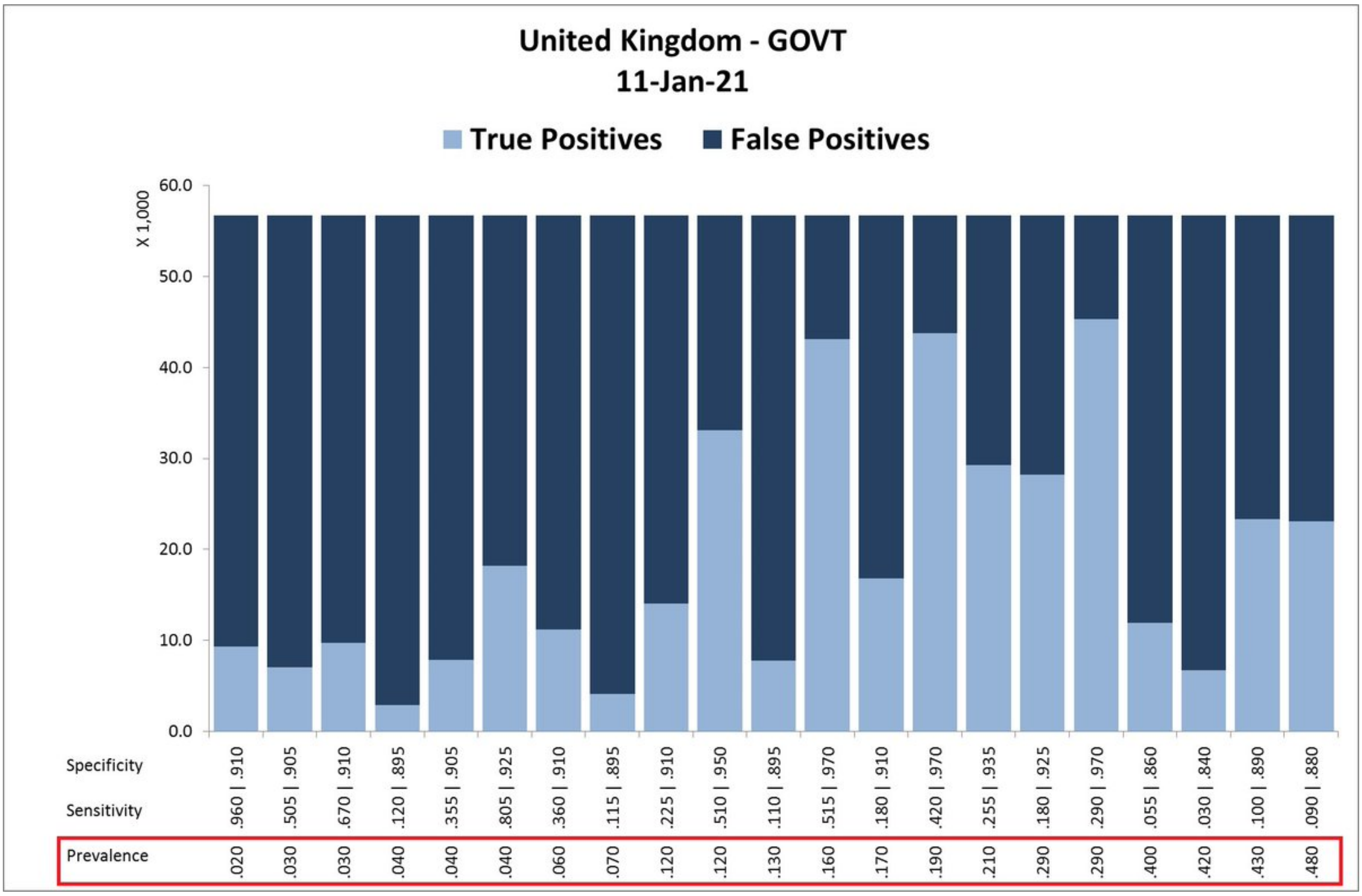


5/ The number of positives and the number of tests are given by the government. Prevalence, specificity, and sensitivity are unknown. So we assume any combination of them ranging from 0-99%. These three combinations can amount up to #millions of #combinations.

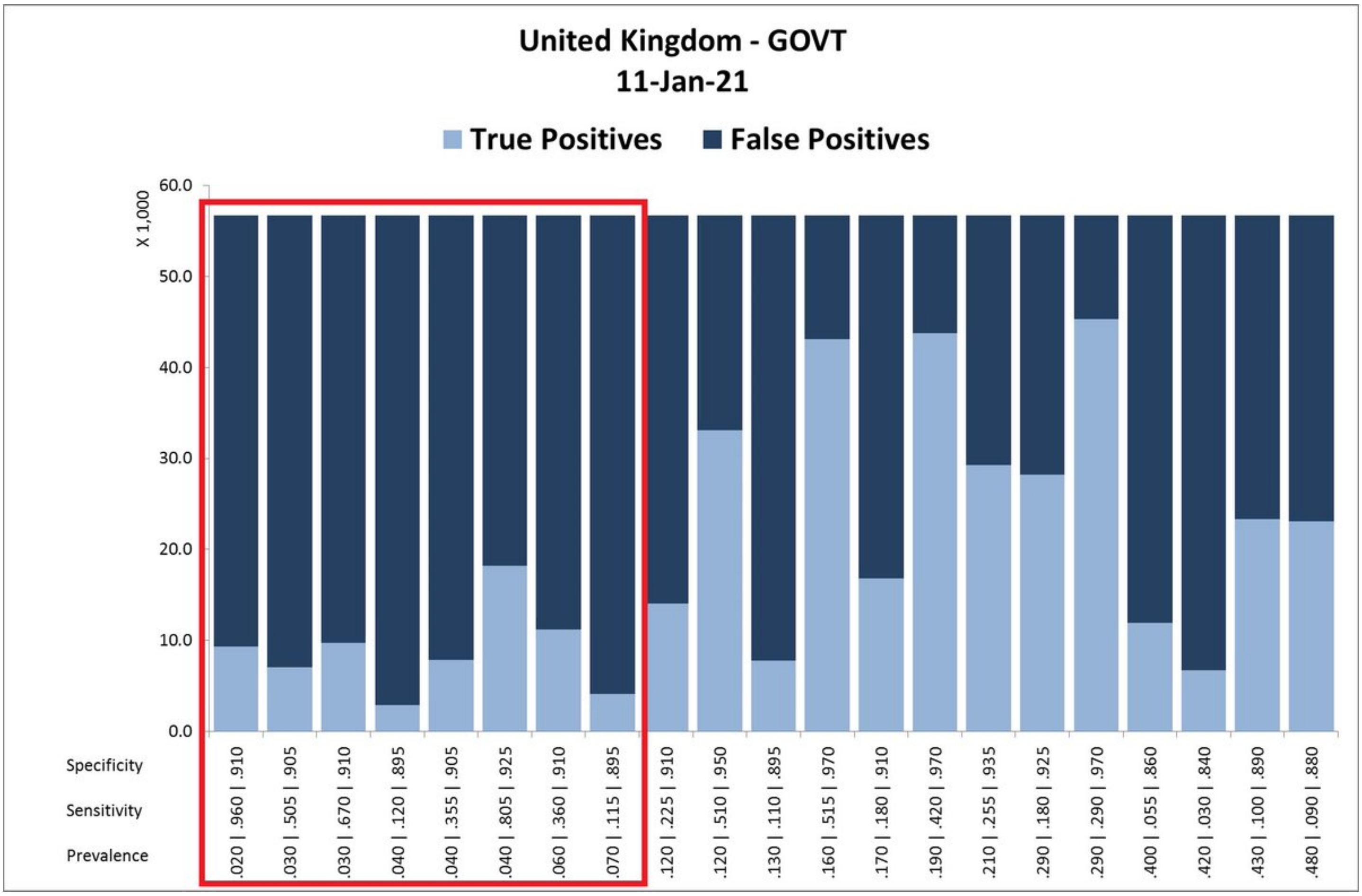
```sql
with tests as
(
select
   :report_id::text as report_id, -- Feel free to call with any string, e.g. date-string
   :tests as tests_performed, -- integer
   :cases as positives_reported --integer
),

permutations as
(
select
   (prevalence::numeric / 1000)::numeric as prevalence,
   (sensitivity::numeric / 1000)::numeric as sensitivity,
   (specificity::numeric / 1000)::numeric as specificity
from
   generate_series(1, 500, 1) as prevalence,
   generate_series(30, 999, 5) as sensitivity,
   generate_series(75, 999, 5) as specificity
),

matrices as
(
select
   t.report_id,
   t.tests_performed,
   t.positives_reported,
   round(prevalence, 2) as prevalence, --just for cosmetic purposes
   round(sensitivity, 3) as sensitivity,
   round(specificity, 3) as specificity,
   (t.tests_performed * prevalence)::int as has_disease, --calculation with full precision for data type numeric, but
   (t.tests_performed * (1 - prevalence))::int as hasnot_disease, --casting to integer for cosmetic purposes
   (t.tests_performed * prevalence * sensitivity)::int as true_positives,
   (t.tests_performed * (1 - prevalence) * specificity)::int as true_negatives
from
   tests t,
   permutations p
)

select
   *,
   hasnot_disease - true_negatives as false_positives,
   has_disease - true_positives as false_negatives
from
   matrices
where
   (true_positives + (hasnot_disease - true_negatives)) = positives_reported
order by
   report_id,
   prevalence,
   sensitivity,
   specificity
```

6/ Typically, we calculate with 7 million combinations. Of these 7 million combinations, only 1-100 usually match the numbers that the government gave us (e.g. TRUE Positives + FALSE Positives = amount of performed tests).

7/ For the 11 Jan 2021, 536,947 tests were performed, resulting in 56,733 reported positives. The confusion matrices contained 21 possible matches for that day, represented in the #columns. We have sorted the columns by ‘prevalence’, as marked in red.



8/ The prevalence in the UK is currently presumed to be 1,52% (https://t.co/DuF3YXRA9s). Given the fact that reported positives dropped by 43% since January 8, we are looking at a prevalence of around 3%, but definitely lower than 12%, leaving us with the following options:

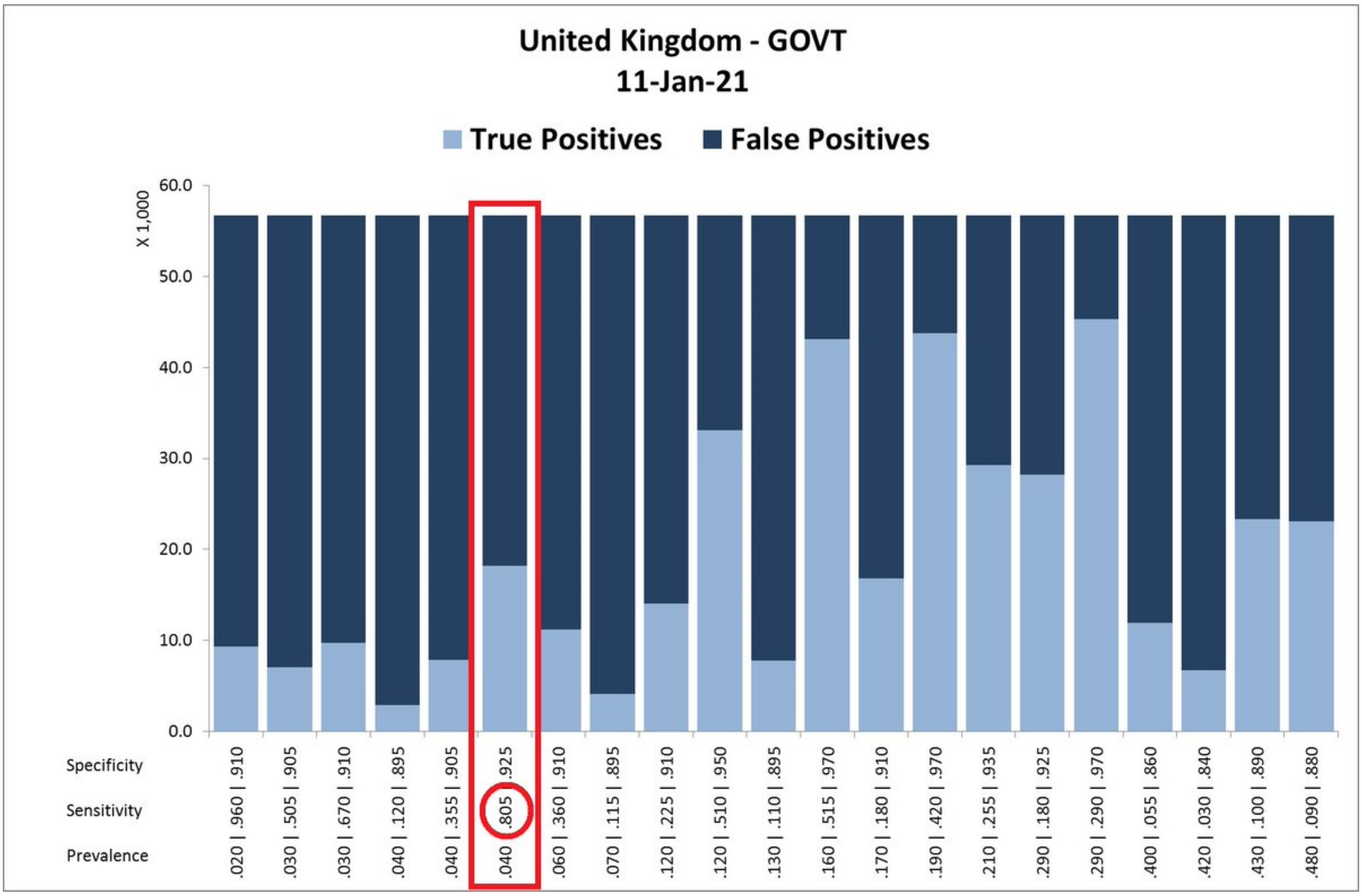


9/ Looking at the bars will already give you a good #indication on the test result in the context of everyone else who got tested in the population. This means that the model tells us whether the test results are/were #relevant.

10/ In the next steps, I will show you how to figure out which event might most likely have been the one that occurred that day, figuring out the real TP/FP rate, test specificity and sensitivity and prevalence. For this, let’s take a look at the tests' sensitivity.

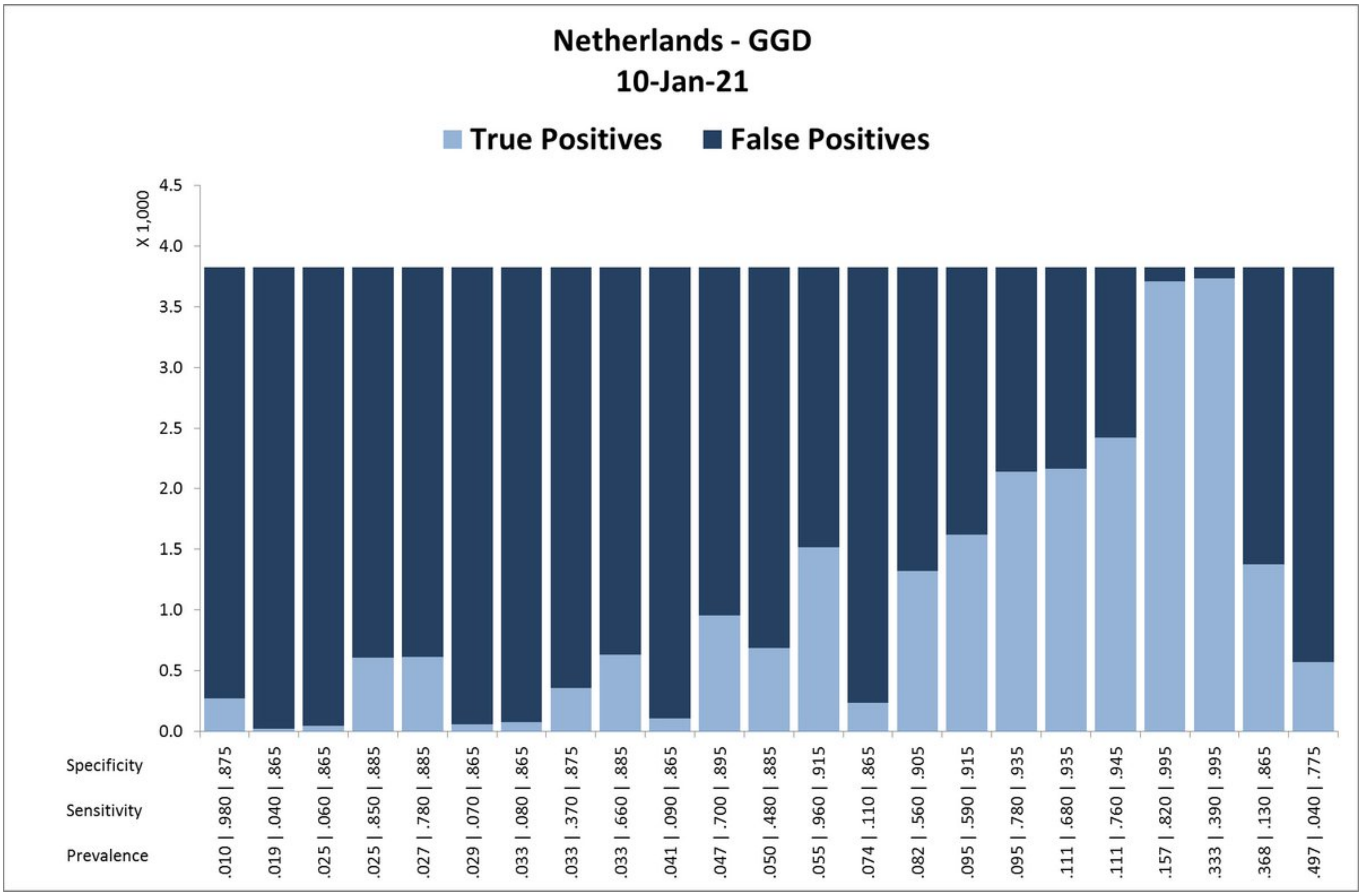
11/ In the UK antigen and PCR tests are used. Antigen tests have a sensitivity between .664 (66.4%) and .738 (73.8%) (https://t.co/9ySnEL8c0l). PCR tests about .842 (84.2%) (https://t.co/guYiZUwW87). PCR tests constitute the majority of tests that are used in the UK.

12/ We are consequently looking for a sensitivity value just below .842. #BINGO! By just getting the amount of performed tests and number of reported positives from the government, we can conclude the actual specificity, sensitivity, and prevalence.

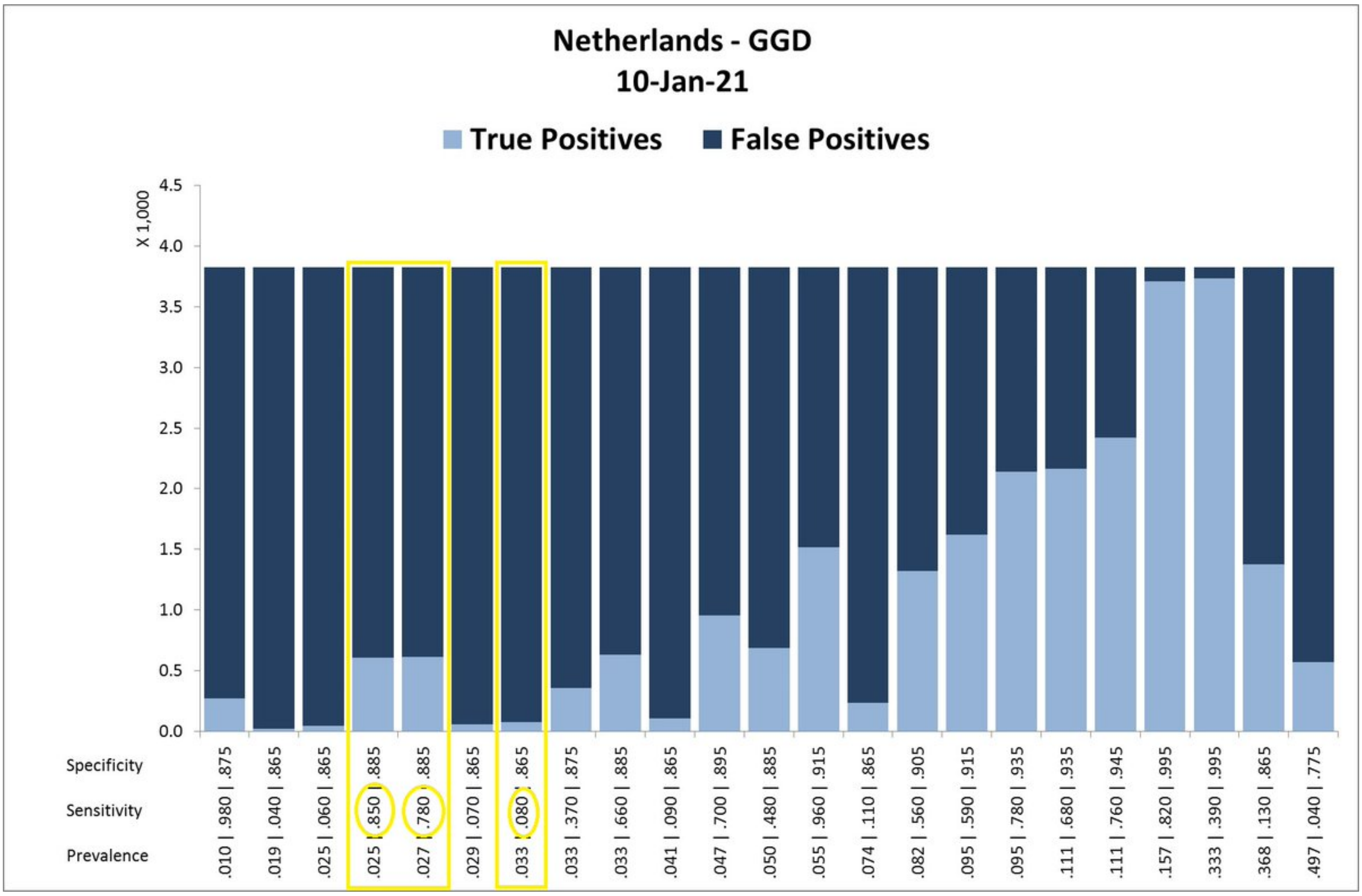


13/ So on January 11th, the prevalence was most likely about 4%, the tests' sensitivity about 80.5%, and the tests' specificity about 92.5% (which is much lower than the claimed 98.9%: https://t.co/Pc4YxhiX07). The false-positive rate that day would consequently have been 68%!

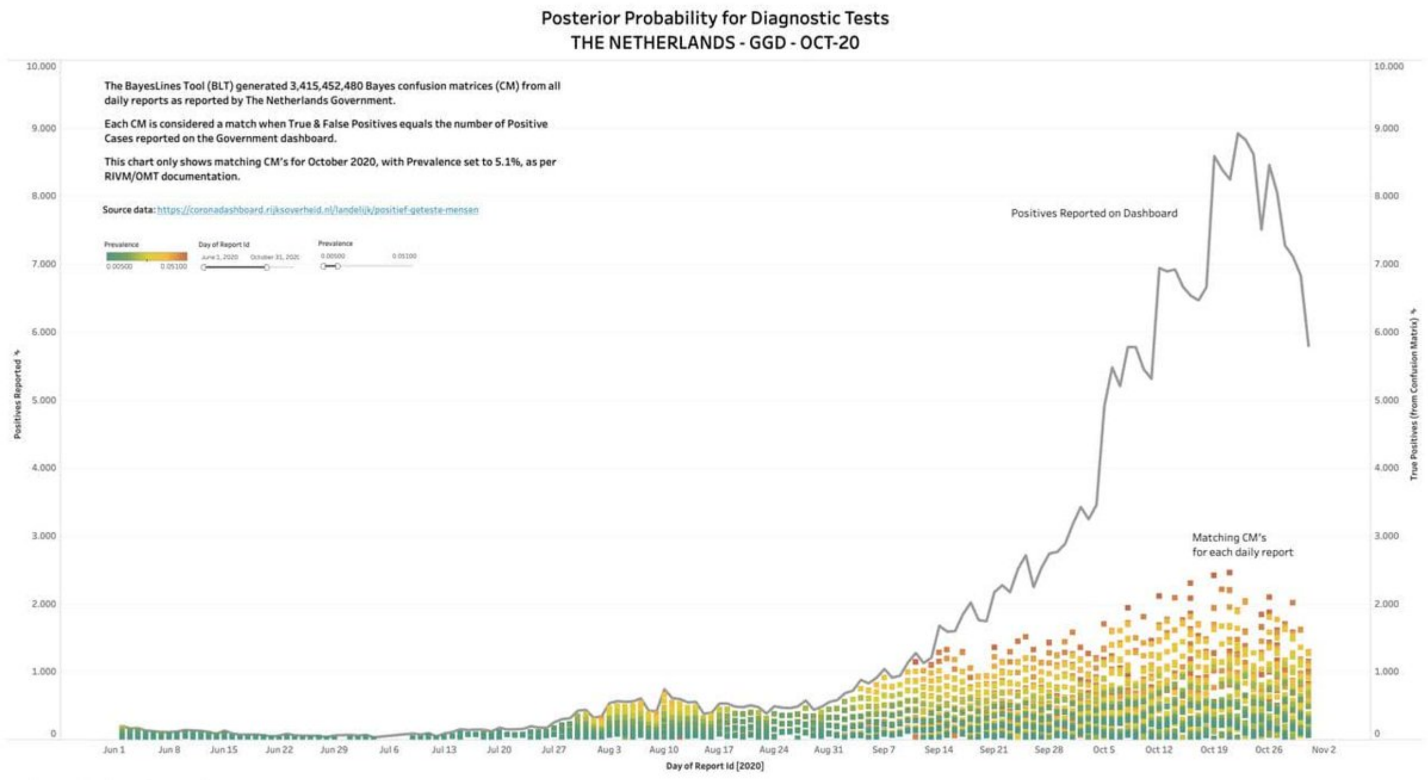
14/ Let's have a look at the calculated data that the Netherlands are providing.



15/ AFAIK, the #Dutch government did not make a recent comment about prevalence, but we can assume a similar one as in the UK. Also, the sensitivity should be in the range of 75-85%, leaving us with the following possible scenarios. Remark: note the low #specificities < 90%.



16/ The model's outcomes are extremely valuable in that they can provide a decision-making tool for people in charge (i.e. #politicians, #physicians, #policymakers etc.) and support them in evaluating their strategy for fighting the disease. #COVID



17/ This time-series can be further back-solved by solving single events following the #exclusionprinciple and consequently receiving insights with respect to the tests' specificity/sensitivity or the prevalence within the population.

18/ This method provides the light (i.e. better insights) for individuals, authorities and governmental agencies that are currently in the dark with measuring problems and often using imprecise prediction models.

19/ Furthermore, the outcomes can provide a better insight into the expectable operational effectiveness of the tests (specificity/sensitivity) compared to the theoretical commercial claims of the manufacturers (equipment, primers, probes, supplies etc.).