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N n- a amet ic t at it ical met h d , hich make fe e a m t i n ab t lat i n e dit ib t i n , ha e e ha been nj t l neglect ed int he anal t ical cience . A maj ad ant age i t hat me f t hem a e im let hat t he can be ed "at t he bench."

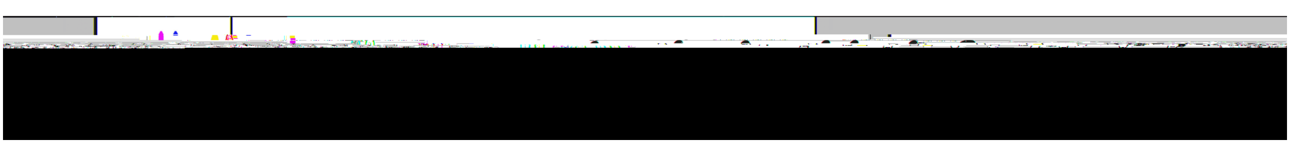
Pa amet e n a amet e ?

Anal ical scien is s generall make replica e meas remen s and rea hem as a random sample, from hich es ima es are made of he proper ies of he (h po he icall infini e) pop- la ion of meas remen s. The pop la ion mean, confidence limi s . are s all calc la ed sing he ass mp ion ha he nderl ing dis rib ion is normal (Ga ssian), i h mean μ and ariance σ^2, . . i can be s mmarised as $N(\mu,\sigma^2)$. The o erms μ and σ are he parame ers of he dis rib ion. Similarl a binomial dis rib ion is described as $B($, $)$, here he parame ers and are respec i el he o al n mber of meas remen s and he probabili of one of he o possible o comes.

This parame er-based approach o da a handling is no essen ial, and ma no al a s be appropria e. Some imes i is kno n ha a pop la ion dis rib ion is no normal or e en close o i , so ded c ions made on he ass mp ion of normali migh be nreliable. This is par ic larl r e in cases here he same meas remen s are made on similar b non-iden ical sample ma erials of na ral origin. The an ibod le els in blood plasma samples from differen h man s bjec s are ro ghl log- normall dis rib ed, i h he addi ion of some s bjec s i h e cep ionall high le els in ario s disease s a es. Me hods ha do no make ass mp ions abo he form of he pop la ion dis rib ion are called non-parame ric or dis rib ion-free me hods. In appl ing hem he familiar approach o significance es ing is s ill sed. We se p a n ll h po hesis H_0 and find he probabili of ob aining he ac al or more e reme res l s if H_0 is r e: if his probabili is er lo H_0 is rejec ed. B heir simplici makes non-parame ric me hods a rac i e e en in si a ions here more familiar es s s ch as he - es migh o her ise be applied, as he e amples belo ill sho .

S me im le e am le

S ppose ha an anal ical reagen is s a ed o ha e a p ri of 99.5%, and ha s ccessi e ba ches are fo nd o ha e p ri le els of 99.2%, 99.8%, 98.9%, 99.4%, 99.1%, 99.3%, and 99.0%. Is here e idence ha he p ri of he ma erial is lo er han i sho ld be? S ch res l s are nlikel o come from a normal pop la ion (after all, he ma im m possible p ri is 100%) so a - es or o her parame ric approach co ld ell be nsafe. A ke s a is ic here is he median: he n ll h po hesis is ha he da a come from a pop la ion i h a median p ri le el of 99.5%. To carr o he es e simpl s b rac his median from each of he e perimen al res l s, and no e he sign of he res l . This gi es si min s signs and one posi i e sign, . . si of he se en res l s lie belo he median. (An res l ha eq als he h po he ical median is ignored comple el). The probabili of ge ing si (or more) min s signs o of se en is pro ided b he binomial heorem, b he al es are pro ided in s a is ical ables, and can be memorised if e al a s make he same n mber of meas remen s. Here he probabili of ge ing 6 or more min s signs is 0.0625, a li le higher han he probabili le el commonl sed in significance es ing ($= 0.05$), so e re ain he n ll h po hesis ha he res l s co ld come from a pop la ion i h a median p ri of 99.5%. As al a s e ha e no pro ed ha he do come from s ch a pop la ion: e ha e



failed o dispro e i . No e ha his is a one- ailed es , as he q es ion is he her he p ri is lo er han i sho ld be. Wi h se en meas remen s he n ll h po hesis o ld onl be rejec ed a he $= 0.05$ le el if all se en res l s gi e min s signs hen compared i h he median al e: his o come has a probabili of onl $(1/2)^7 = 1/128$. This me hod is called he sign es , and i can be e ended o o her si a ions, s ch as comparing o se s of paired res l s, or s d ing a possible rend in a seq ence of res l s.