A software tool for parametric estimation of Bayesian medical diagnostic measures and their uncertainty

Supplemental Figures

Version 1.0.0

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1. Introduction

This supplement displays in figures S1-S49 the output of the program *Bayesian Diagnostic Measures*. Each figure is described by its title. The parameter settings, obtained from the '*Illustrative Case Study'* of the article "A software tool for parametric estimation of Bayesian medical diagnostic measures and their uncertainty", are presented in tables S1-S9. The symbols used in tables and figures are explained in the 'Notation' section.

2. Diagnostic Measures Plots

2.1. Diagnostic Measures vs Measurement Value

Table S1

	Figures S1	**Figures S2**	**Figure S3**	**Figure S4**
t	32.0– 210.0	67.0– 157.0	126.0	126.0
μ_D	120.8	120.8	120.8	120.8
σ_D	17.7	17.7	17.7	17.7
n_D	154	154	154	154
$\mu_{\overline{D}}$	102.6	102.6	102.6	102.6
$\sigma_{\overline{D}}$	10.7	10.7	10.7	10.7
$n_{\overline{D}}$	822	822	822	822
v	0.158	0.158	0.001-0.999	0.001-0.200
b_0	0.866	0.866	0.866	0.866
b_1	0.0109	0.0109	0.0109	0.0109
d_D	lognormal	lognormal	lognormal	lognormal
$d_{\overline{D}}$	lognormal	lognormal	lognormal	lognormal

The parameter settings of the figures S1 - S4

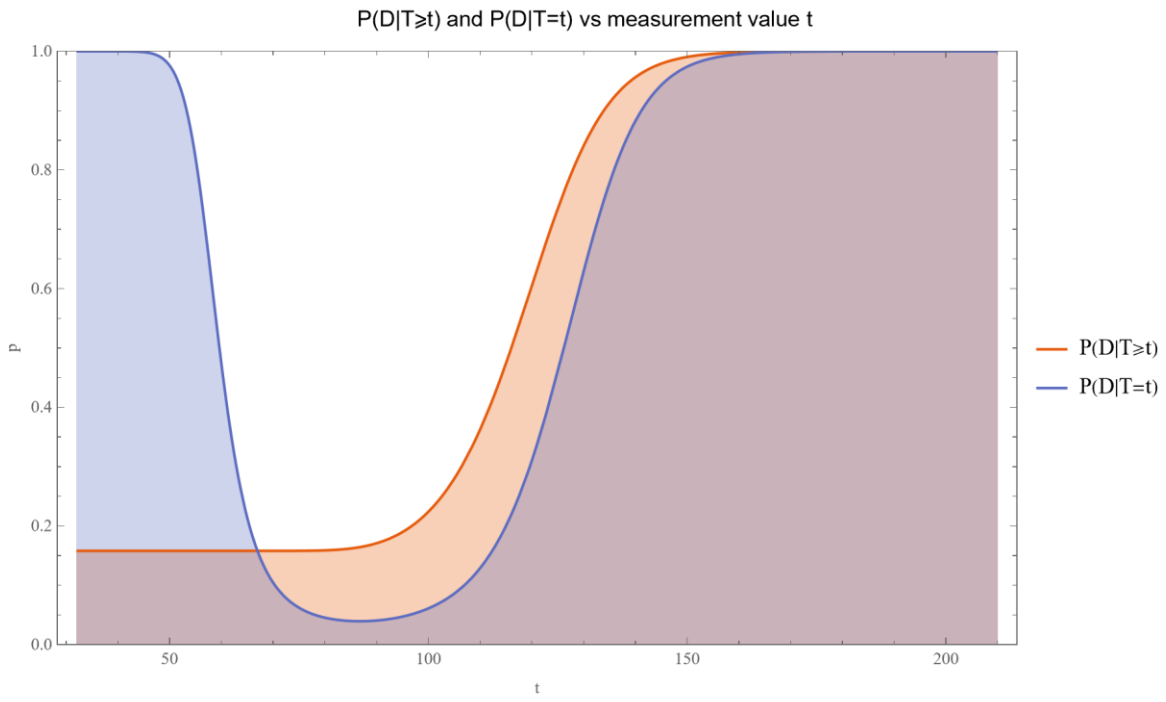

Figure S1, with the parameter settings in Table S1.

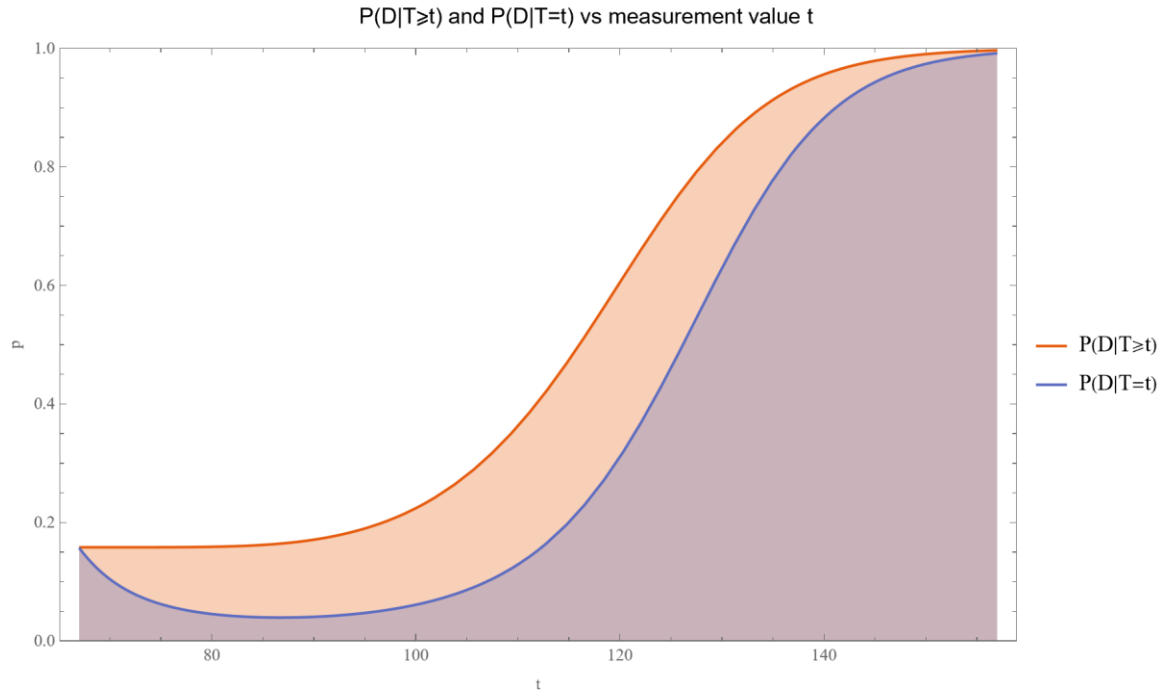

Figure S2, with the parameter settings in Table S1.

2.2.Diagnostic Measures vs Prevalence of Disease

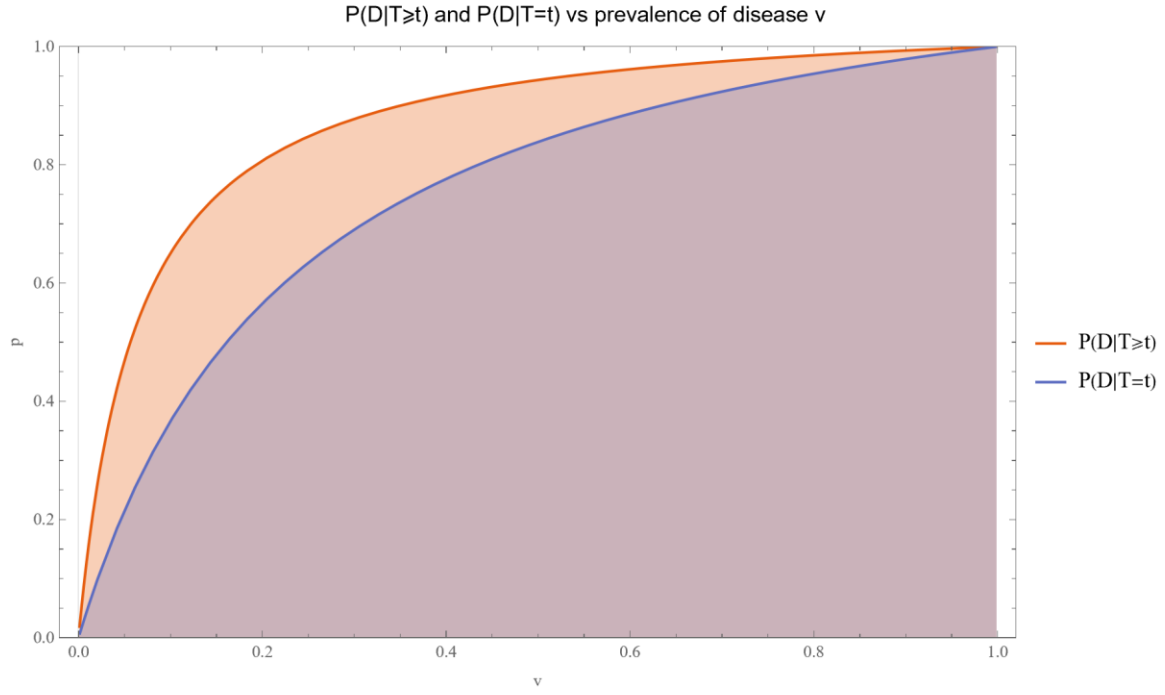

Figure S3, with the parameter settings in Table S1.

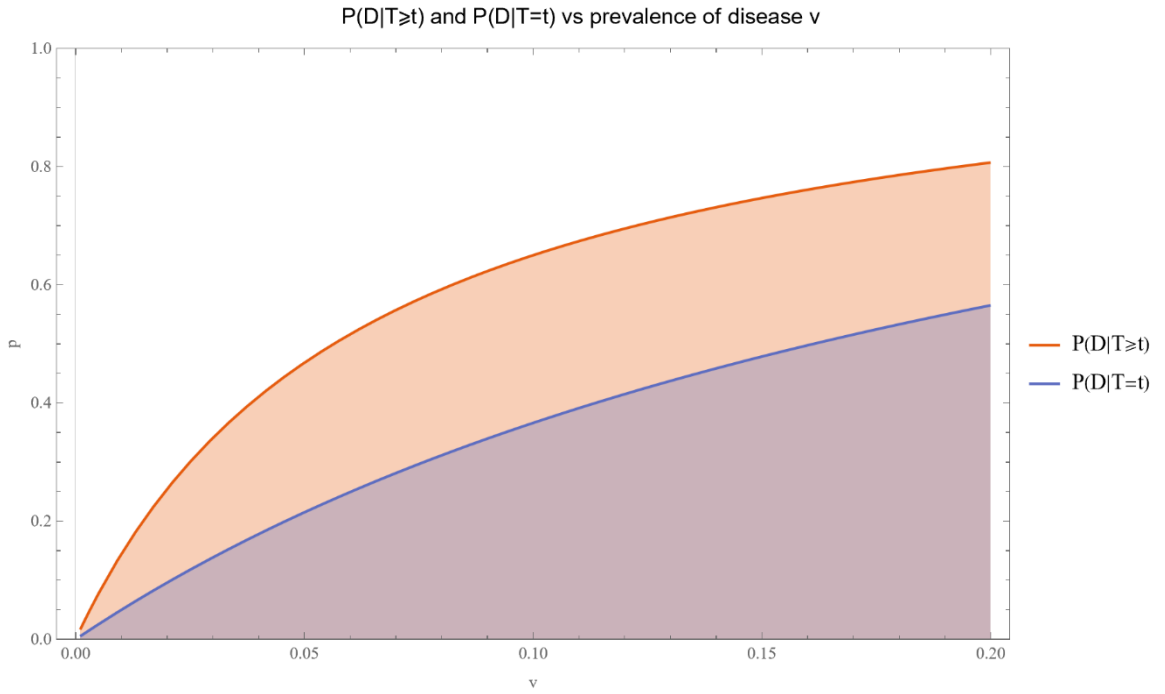

Figure S4, with the parameter settings in Table S1.

2.3.Diagnostic Measures Ratio vs Measurement Value

Table S2

	Figures S5	**Figures S6**	**Figure S7**	**Figure S8**
t	32.0– 210.0	67.0– 157.0	126.0	126.0
μ_D	120.8	120.8	120.8	120.8
σ_D	17.7	17.7	17.7	17.7
n_D	154	154	154	154
$\mu_{\overline{D}}$	102.6	102.6	102.6	102.6
$\sigma_{\overline{D}}$	10.7	10.7	10.7	10.7
$n_{\overline{D}}$	822	822	822	822
v	0.158	0.158	0.001-0.999	0.001-0.200
b_0	0.866	0.866	0.866	0.866
b_1	0.0109	0.0109	0.0109	0.0109
d_D	lognormal	lognormal	lognormal	lognormal
$d_{\overline{D}}$	lognormal	lognormal	lognormal	lognormal

The parameter settings of the figures S5 - S8

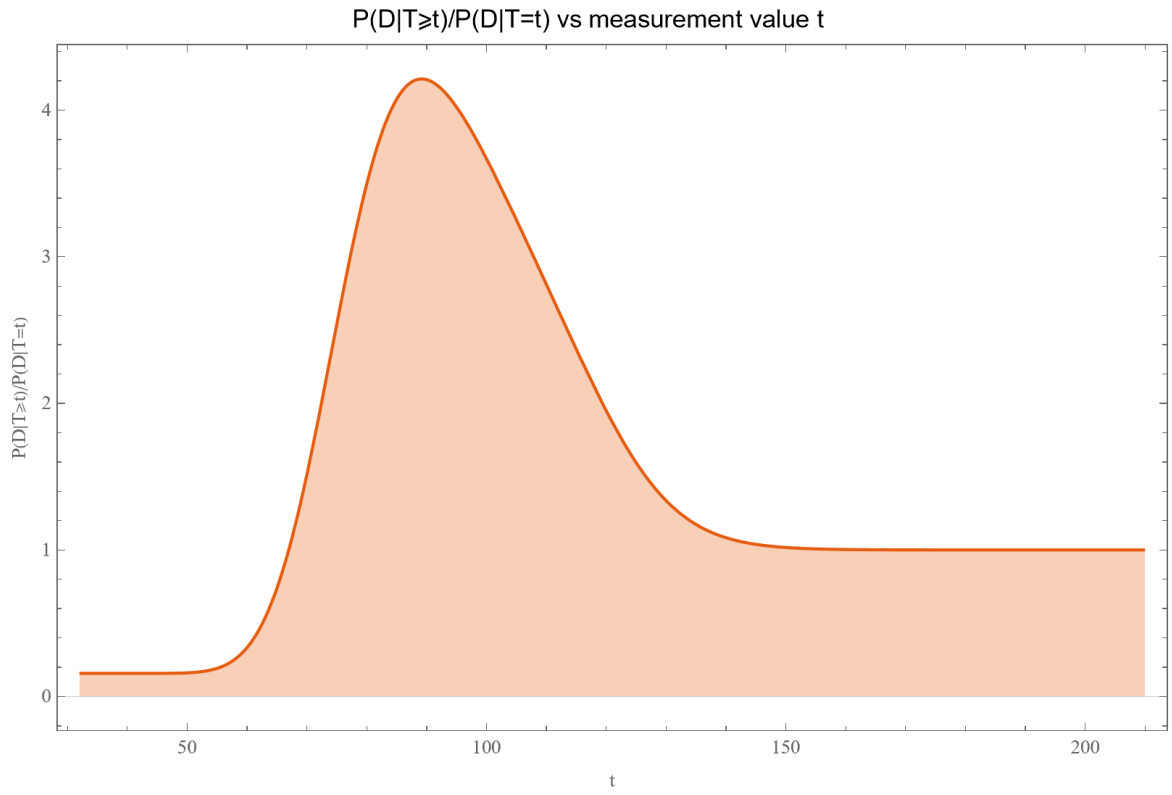

Figure S5, with the parameter settings in Table S2.

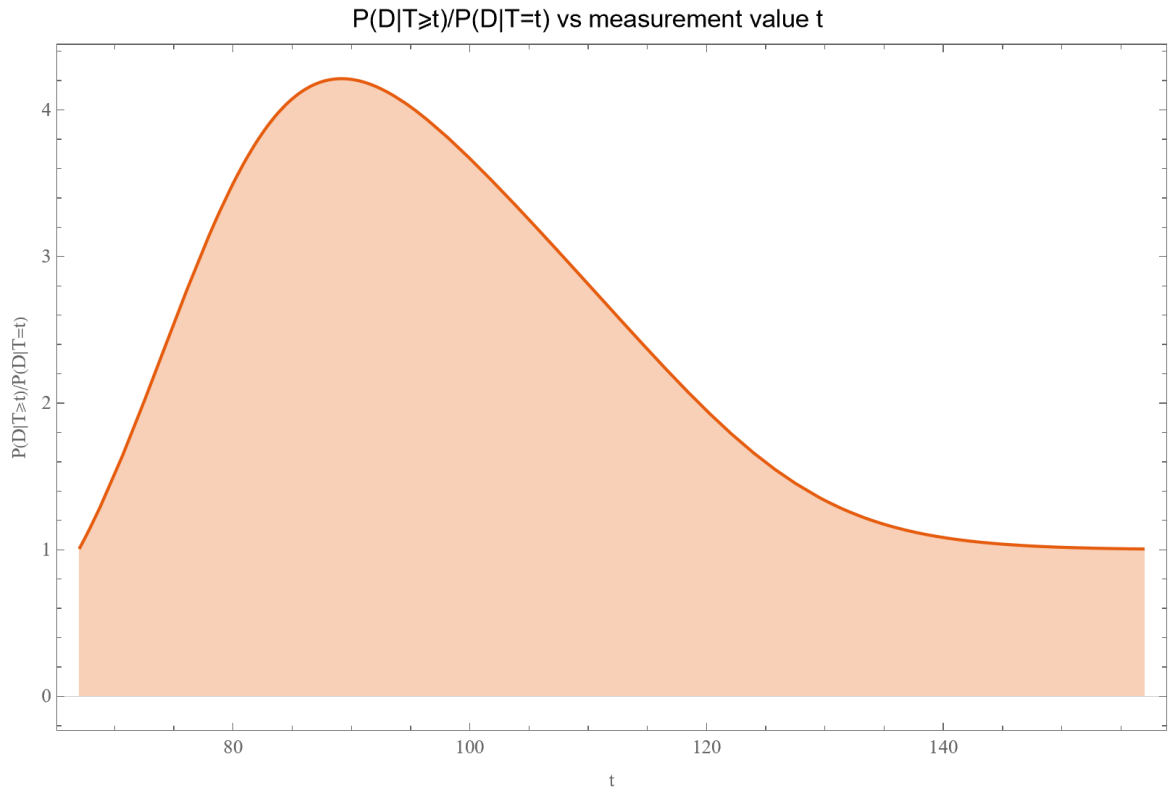

Figure S6, with the parameter settings in Table S2.

2.4.Diagnostic Measures Ratios vs Prevalence of Disease

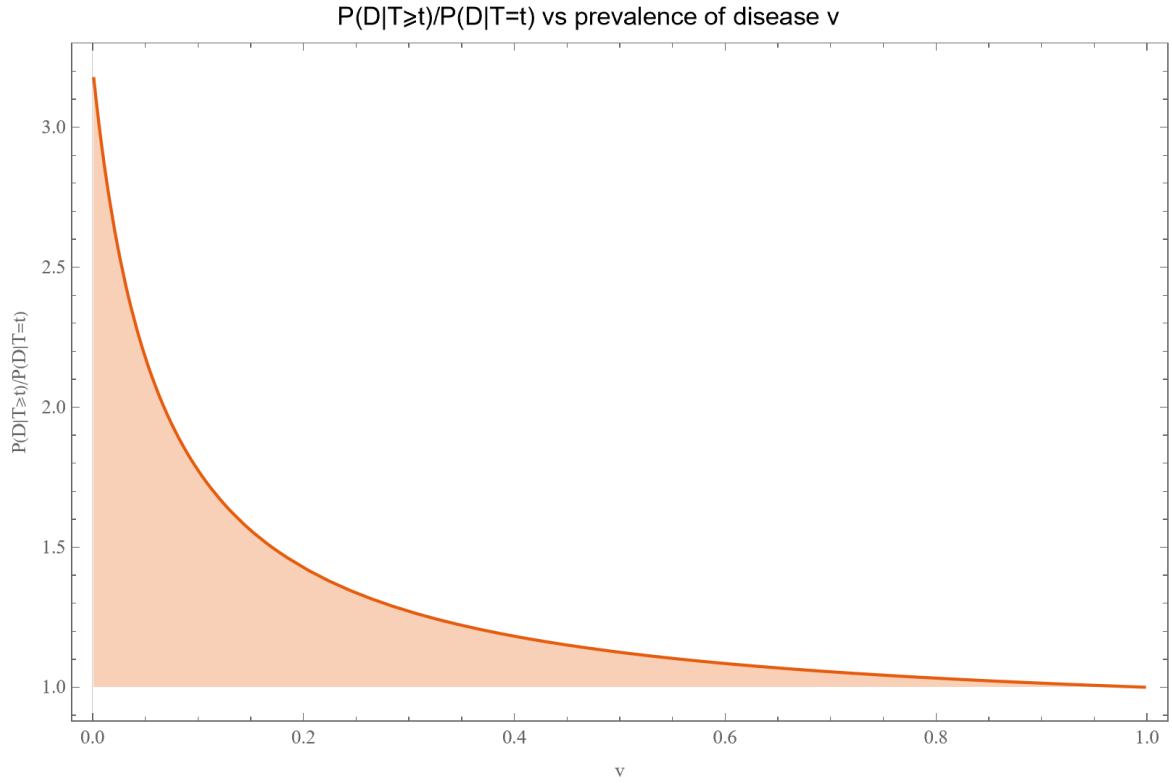

Figure S7, with the parameter settings in Table S2.

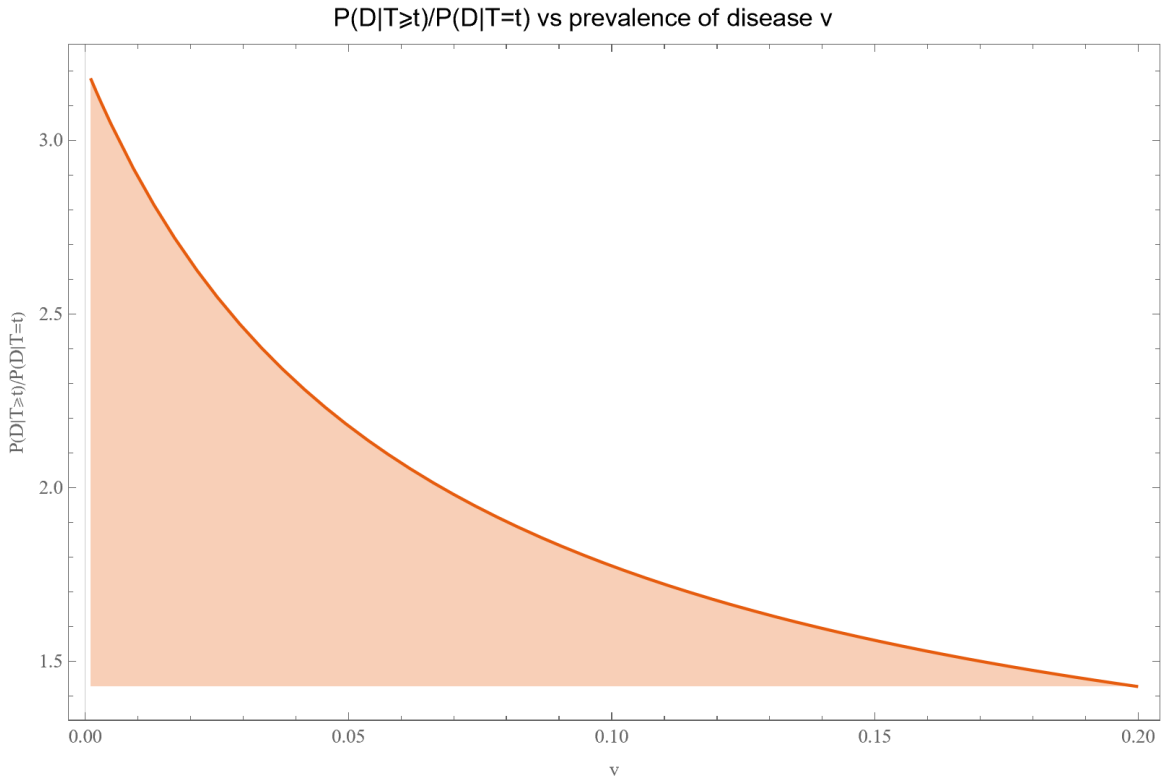

Figure S8, with the parameter settings in Table S2.

3. Diagnostic Measures Tables

Table S3

	Figures S9-S10
t	126.0
μ_D	120.8
σ_D	17.7
n_D	154
$\mu_{\overline{D}}$	102.6
$\sigma_{\overline{D}}$	10.7
$n_{\overline{D}}$	822
v	0.158
b_0	0.866
b_1	0.0109
d_D	normal lognormal gamma
$d_{\overline{D}}$	normal lognormal gamma

The parameter settings of the figures S9 - S10

3.1.Diagnostic Measures

diagnostic measures			
measurand distribution		measure	
diseased	nondiseased	P(D|T≥t)	P(D|T=t)
normal	normal	0.833	0.542
	lognormal	0.771	0.509
	gamma	0.790	0.516
lognormal	normal	0.823	0.527
	lognormal	0.758	0.494
	gamma	0.778	0.501
gamma	normal	0.827	0.532
	lognormal	0.763	0.498
	gamma	0.783	0.505

Figure S9, with the parameter settings in Table S3.

3.2.Diagnostic Measures ratios

diagnostic measures ratio		
measurand distribution		diagnostic measures ratio
diseased	nondiseased	P(D|T≥t)/P(D|T=t)
normal	normal	1.536
	lognormal	1.514
	gamma	1.530
lognormal	normal	1.561
	lognormal	1.535
	gamma	1.553
gamma	normal	1.555
	lognormal	1.531
	gamma	1.548

Figure S10, with the parameter settings in Table S3.

4. Standard Uncertainty Plots

4.1.Standard Uncertainty vs Measurement Value

Table S4

	Figures S11, S13	**Figures S12, S14**	**Figure S15**	**Figure S16**
p	-	-	0.95	0.95
t	32.0– 210.0	67.0– 157.0	32.0– 210.0	67.0– 157.0
μ_D	120.8	120.8	120.8	120.8
σ_D	17.7	17.7	17.7	17.7
n_D	154	154	154	154
$\mu_{\overline{D}}$	102.6	102.6	102.6	102.6
$\sigma_{\overline{D}}$	10.7	10.7	10.7	10.7
$n_{\overline{D}}$	822	822	822	822
v	0.158	0.158	0.158	0.158
b_0	0.866	0.866	0.866	0.866
b_1	0.0109	0.0109	0.0109	0.0109
n_U	-	-	1350	1350
d_D	lognormal	lognormal	lognormal	lognormal
$d_{\overline{D}}$	lognormal	lognormal	lognormal	lognormal

The parameter settings of the figures S11 – S16

4.1.1. Standard Uncertainty

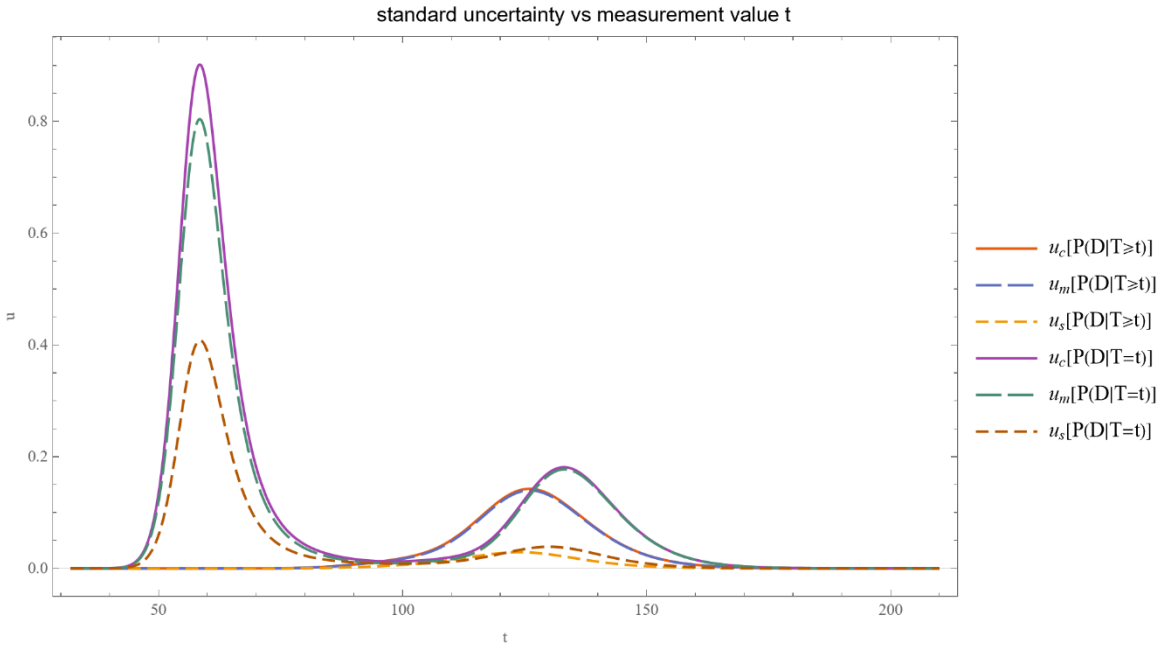

Figure S11, with the parameter settings in Table S4.

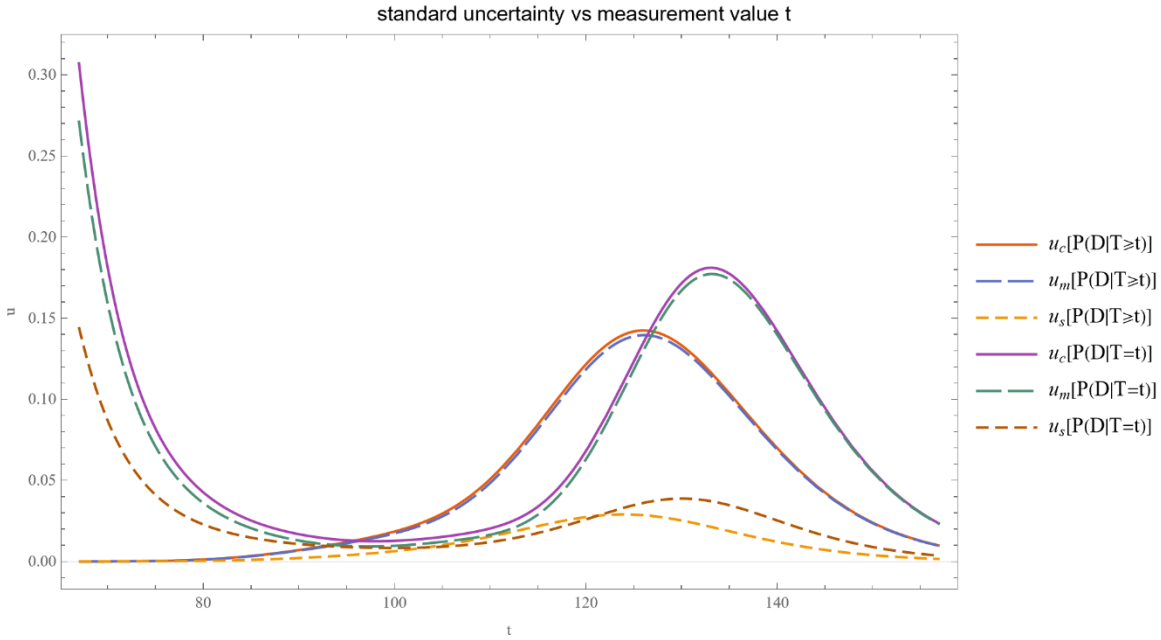

Figure S12, with the parameter settings in Table S4.

4.1.2. Relative Standard Uncertainty

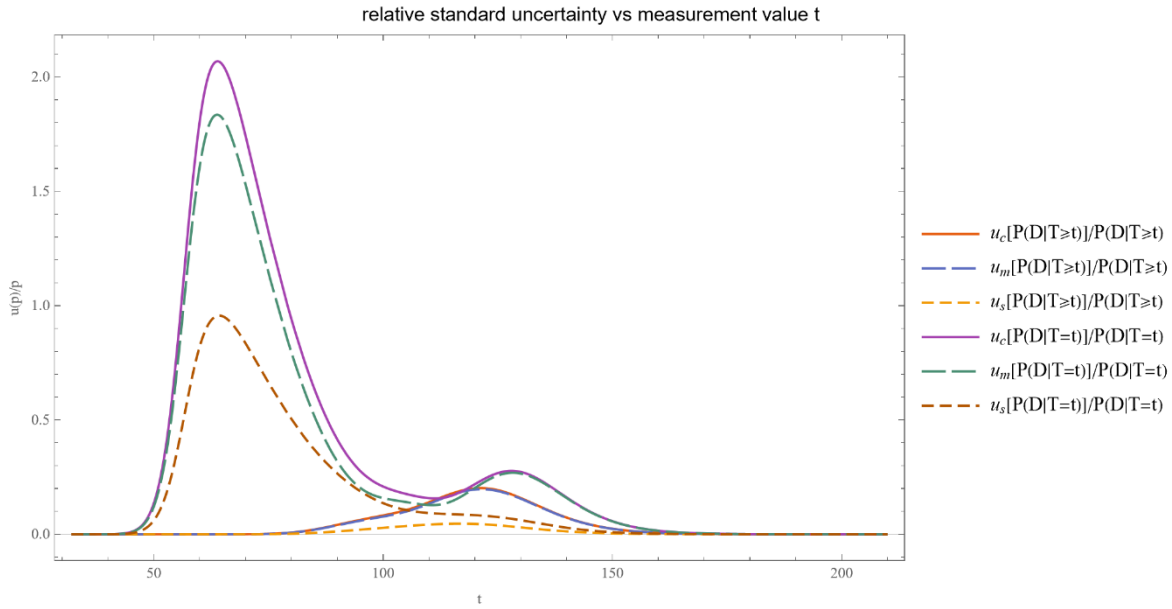

Figure S13, with the parameter settings in Table S4.

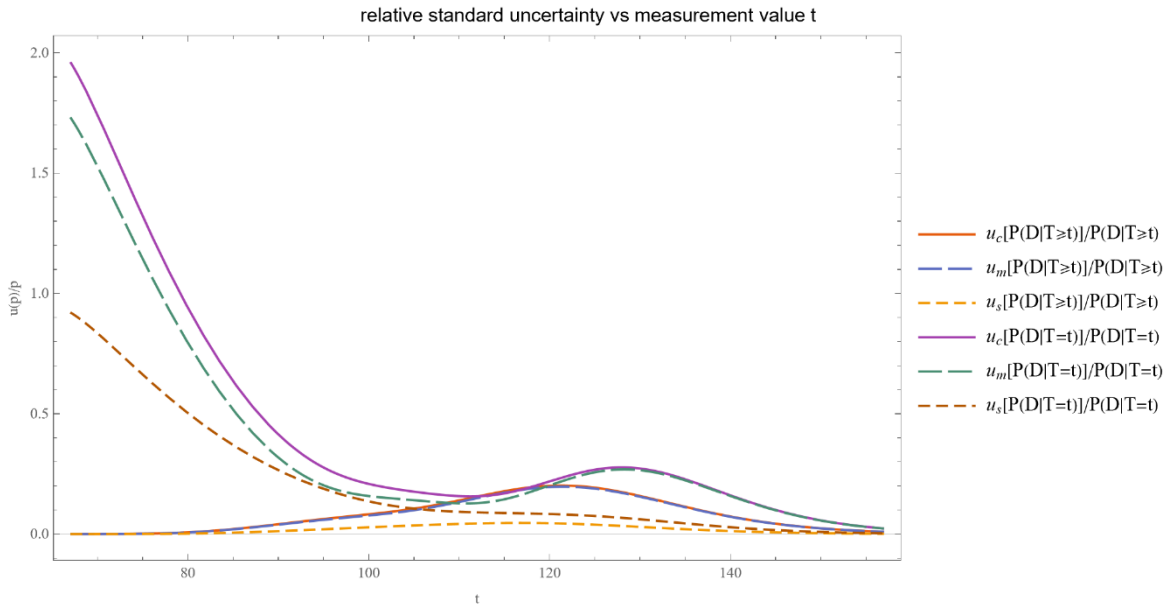

Figure S14, with the parameter settings in Table S4.

4.1.3. Confidence Intervals

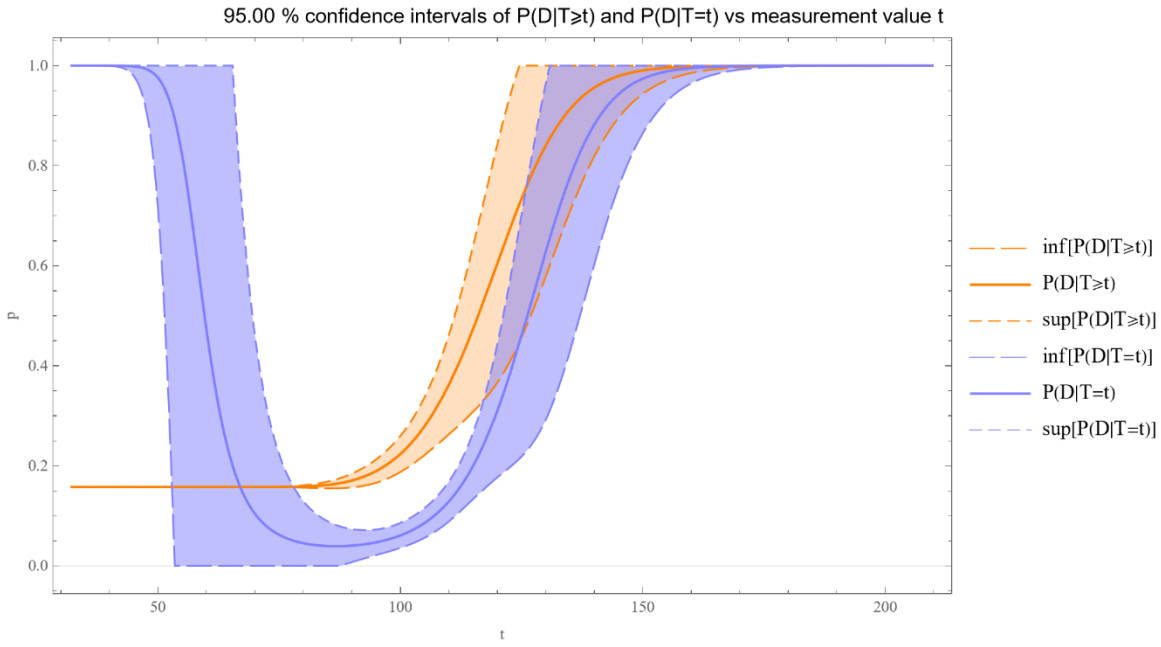

Figure S15, with the parameter settings in Table S4.

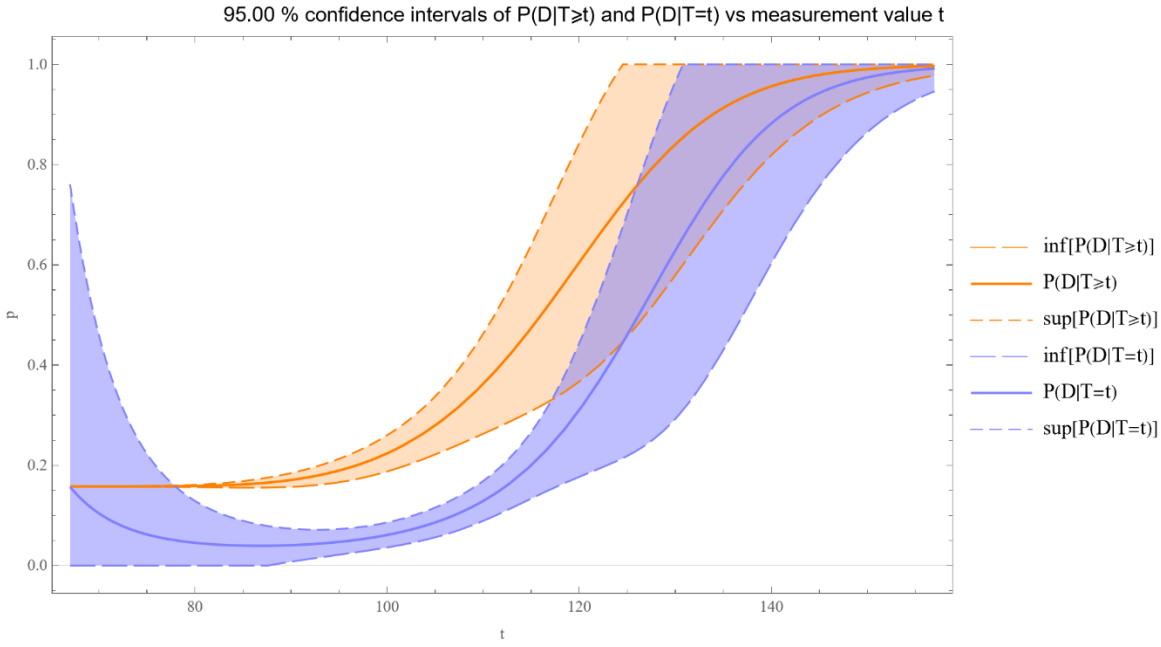

Figure S16, with the parameter settings in Table S4.

4.2. Standard Uncertainty vs Constant Contribution to Measurement Uncertainty

Table S5

	Figures S17, S19	**Figures S18, S20**	**Figure S21**	**Figure S22**
p	-	-	0.95	0.95
t	126.0	126.0	126.0	126.0
μ_D	120.8	120.8	120.8	120.8
σ_D	17.7	17.7	17.7	17.7
n_D	154	154	154	154
$\mu_{\overline{D}}$	102.6	102.6	102.6	102.6
$\sigma_{\overline{D}}$	10.7	10.7	10.7	10.7
$n_{\overline{D}}$	822	822	822	822
v	0.158	0.158	0.158	0.158
b_0	$0.0 - 5.35$	$0.0 - 1.605$	$0.0 - 5.35$	$0.0 - 1.605$
b_1	0.0109	0.0109	0.0109	0.0109
n_U	-	-	1350	1350
d_D	lognormal	lognormal	lognormal	lognormal
$d_{\overline{D}}$	lognormal	lognormal	lognormal	lognormal

The parameter settings of the figures S17 - S22

4.2.1. Standard Uncertainty

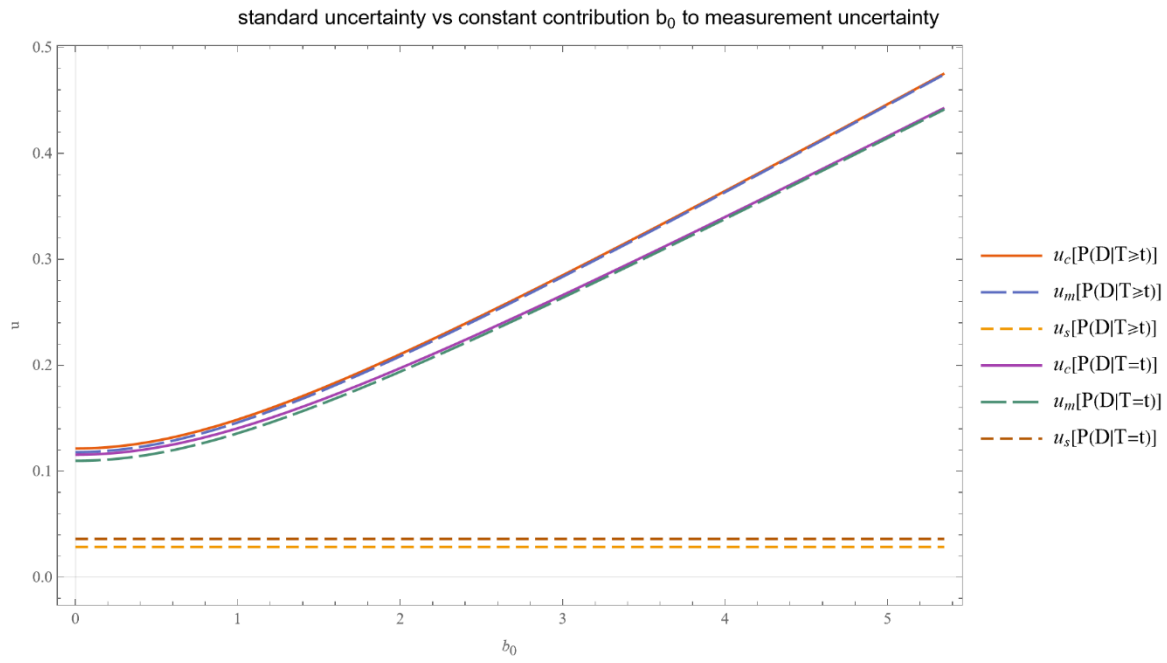

Figure S17, with the parameter settings in Table S5.

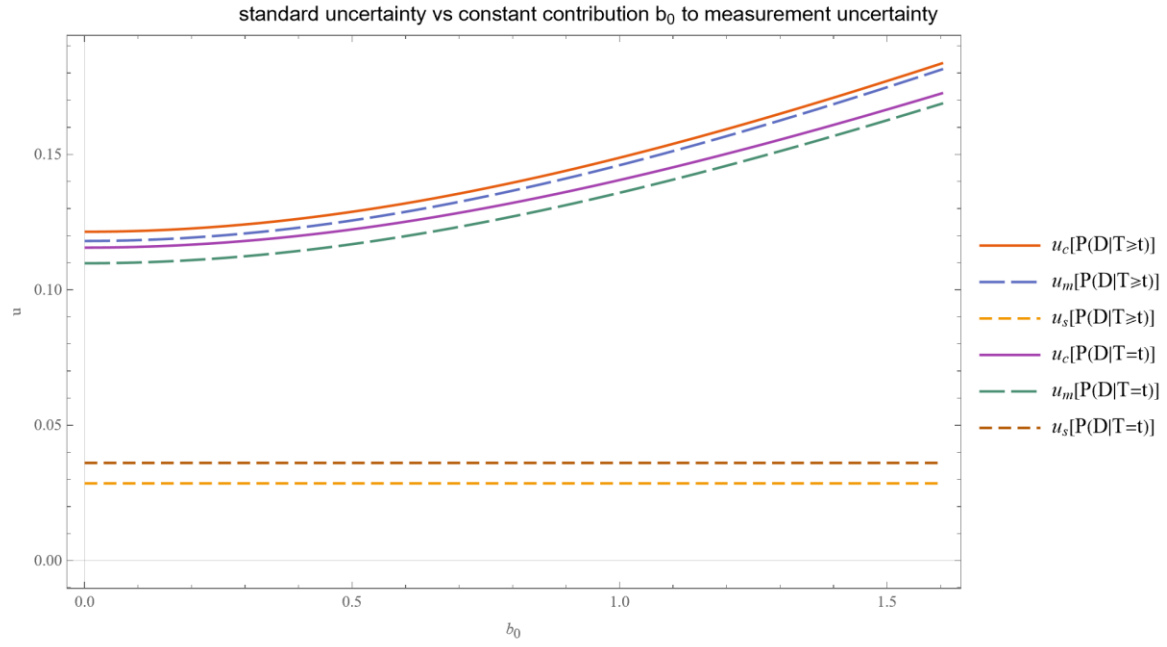

Figure S18, with the parameter settings in Table S5.

4.2.2. Relative Standard Uncertainty

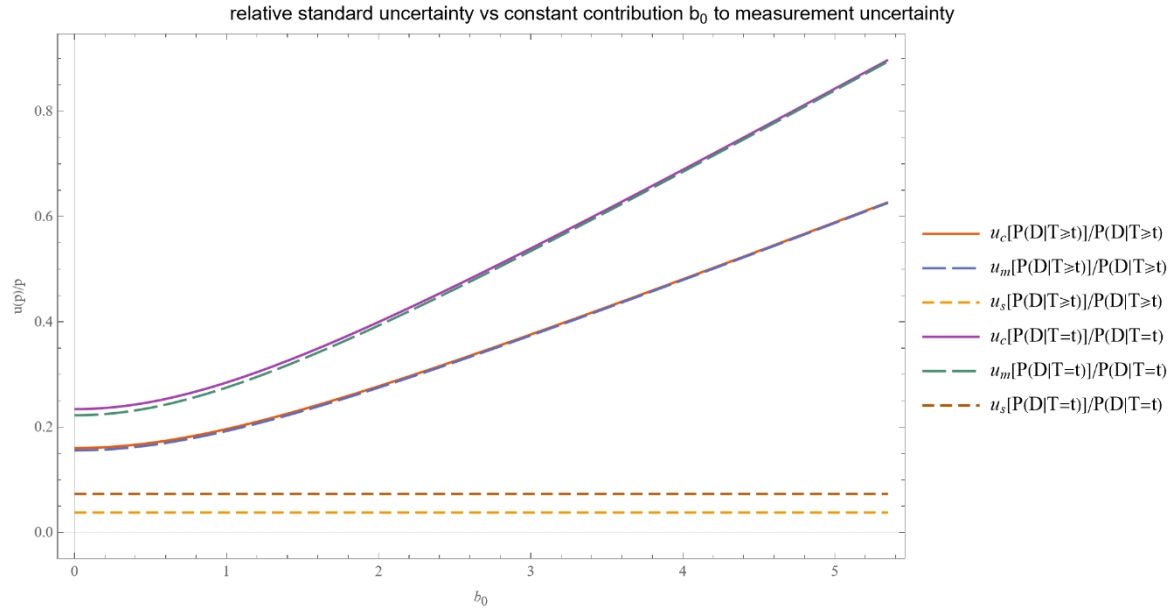

Figure S19, with the parameter settings in Table S5.

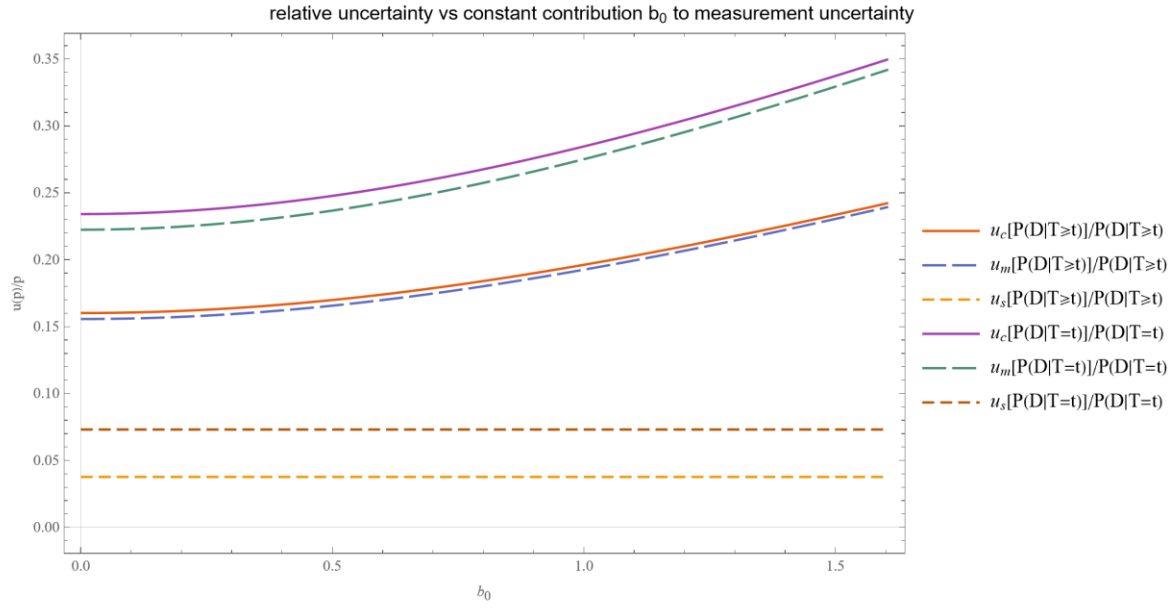

Figure S20, with the parameter settings in Table S5.

4.2.3. Confidence Intervals

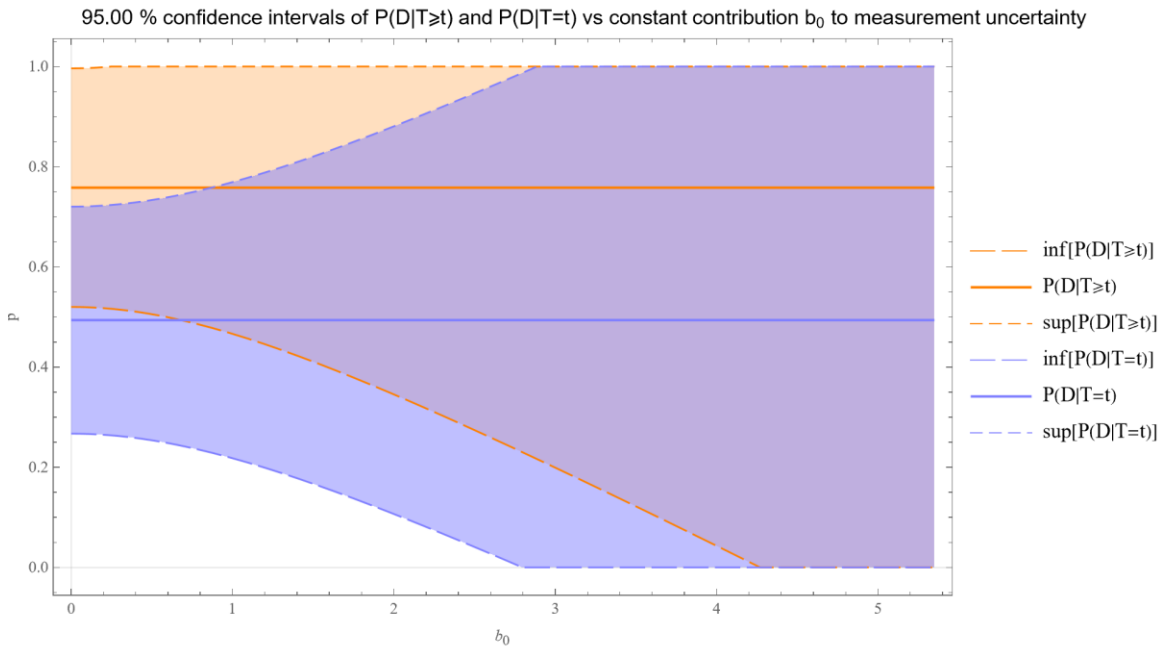

Figure S21, with the parameter settings in Table S5.

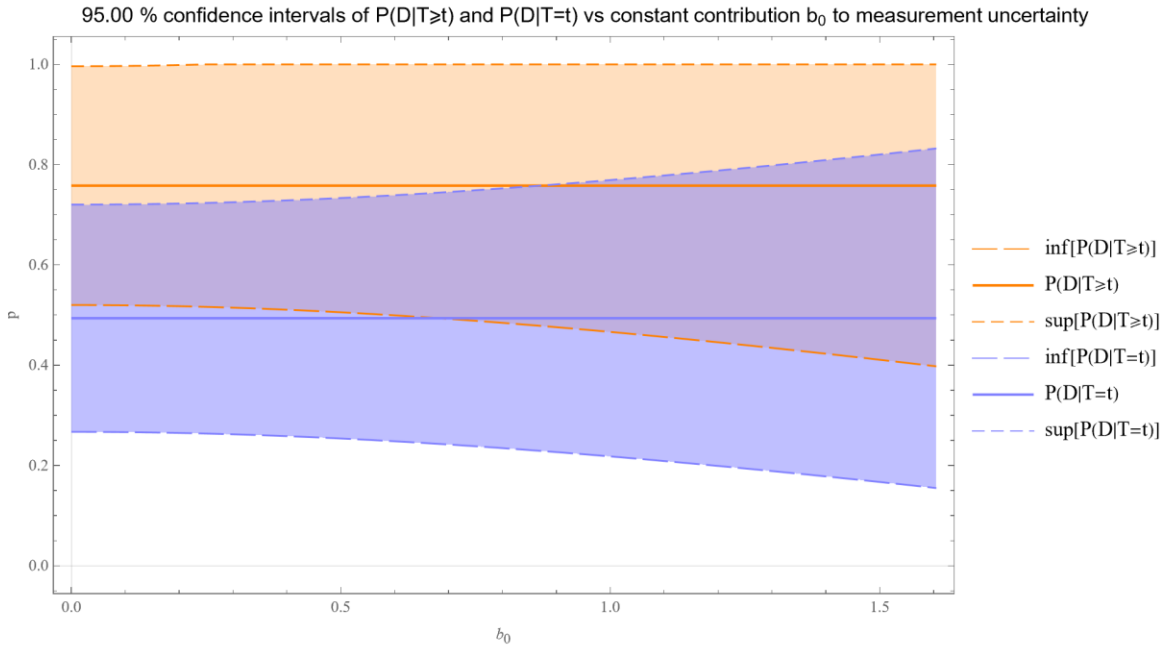

Figure S22, with the parameter settings in Table S5.

4.3.Standard Uncertainty vs Measurement Uncertainty Proportionality Constant

Table S6

	Figures S23, S25	**Figures S24,S26**	**Figure S27**	**Figure S28**
p	-	-	0.95	0.95
t	126.0	126.0	126.0	126.0
μ_D	120.8	120.8	120.8	120.8
σ_D	17.7	17.7	17.7	17.7
n_D	154	154	154	154
$\mu_{\overline{D}}$	102.6	102.6	102.6	102.6
$\sigma_{\overline{D}}$	10.7	10.7	10.7	10.7
$n_{\overline{D}}$	822	822	822	822
v	0.158	0.158	0.158	0.158
b_0	0.866	0.866	0.866	0.866
b_1	$0.0 - 0.200$	$0.0 - 0.020$	$0.0 - 0.200$	$0.0 - 0.020$
n_U	-	-	1350	1350
d_D	lognormal	lognormal	lognormal	lognormal
$d_{\overline{D}}$	lognormal	lognormal	lognormal	lognormal

The parameter settings of the figures S23 – S28

4.3.1. Standard Uncertainty

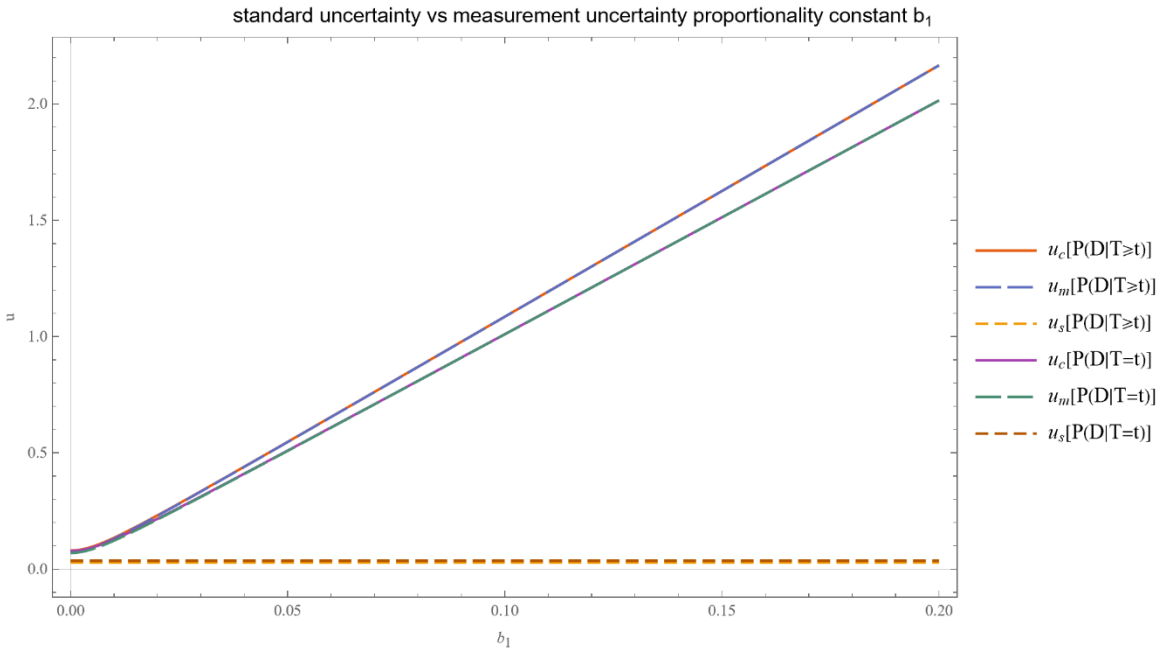

Figure S23, with the parameter settings in Table S6.

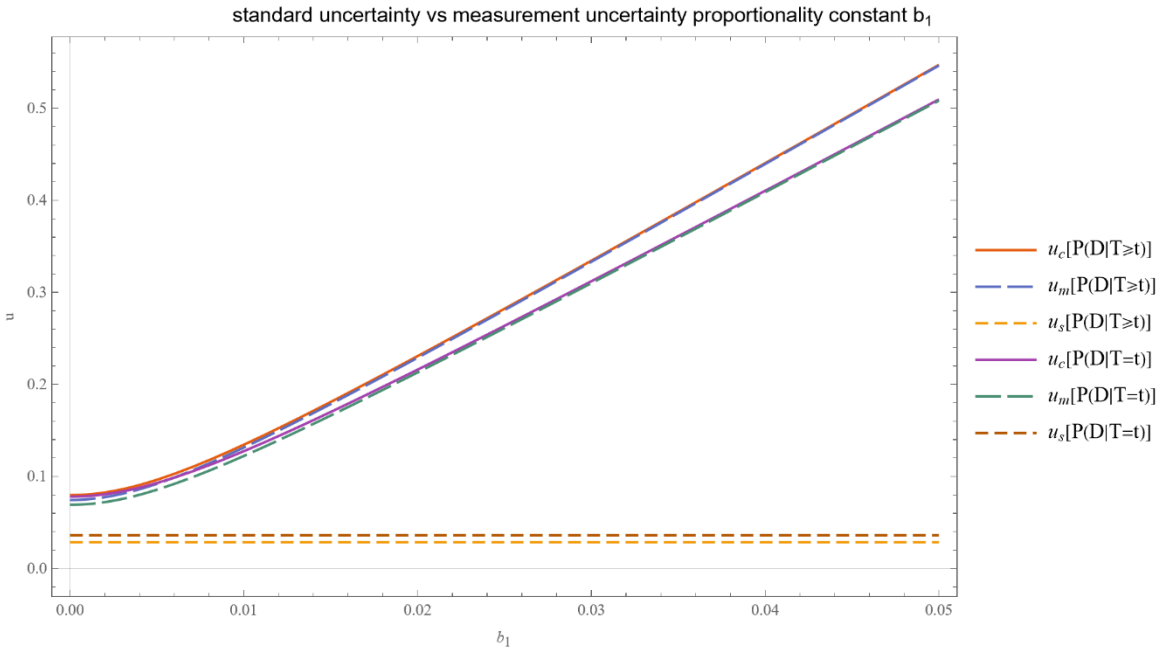

Figure S24, with the parameter settings in Table S6.

4.3.3. Relative Standard Uncertainty

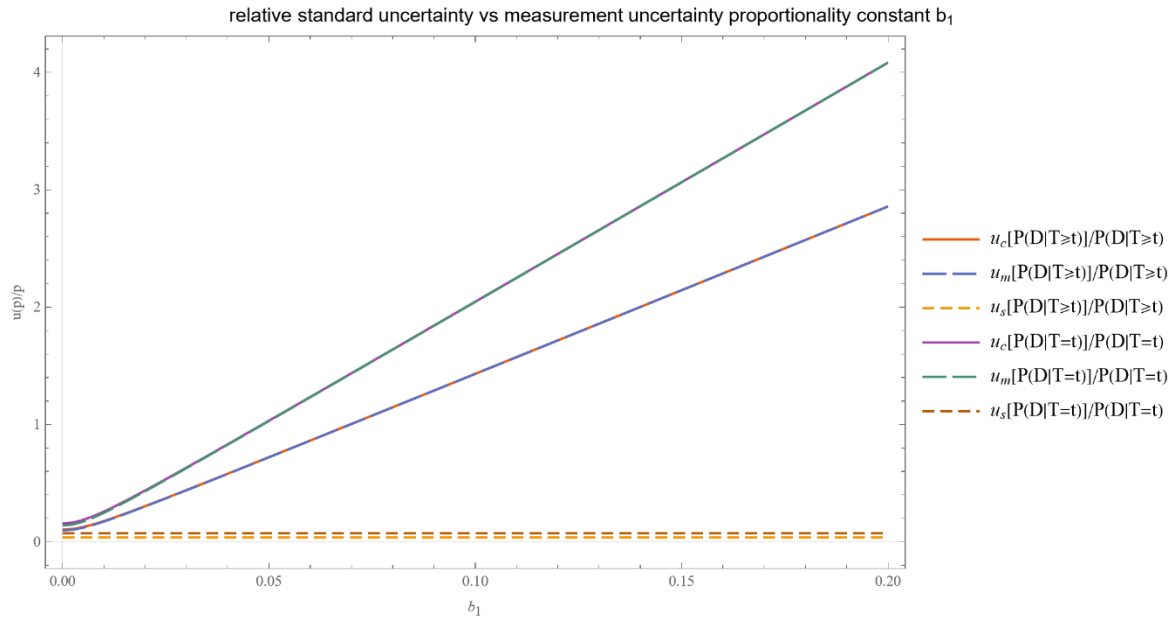

Figure S25, with the parameter settings in Table S6.

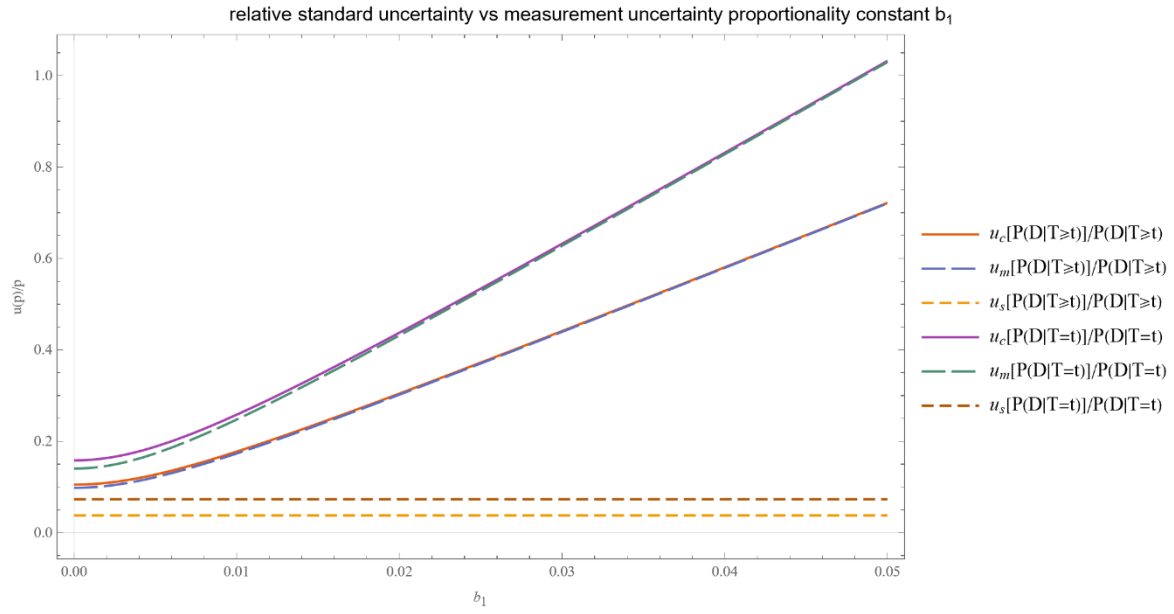

Figure S26, with the parameter settings in Table S6.

4.3.5. Confidence Intervals

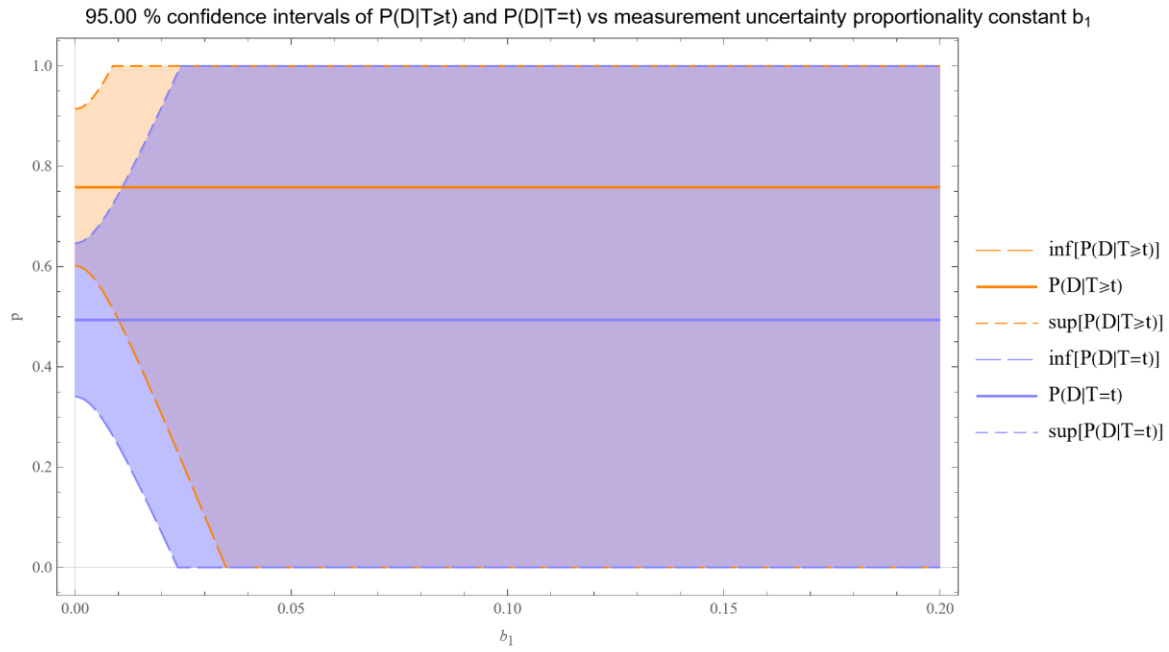

Figure S27, with the parameter settings in Table S6.

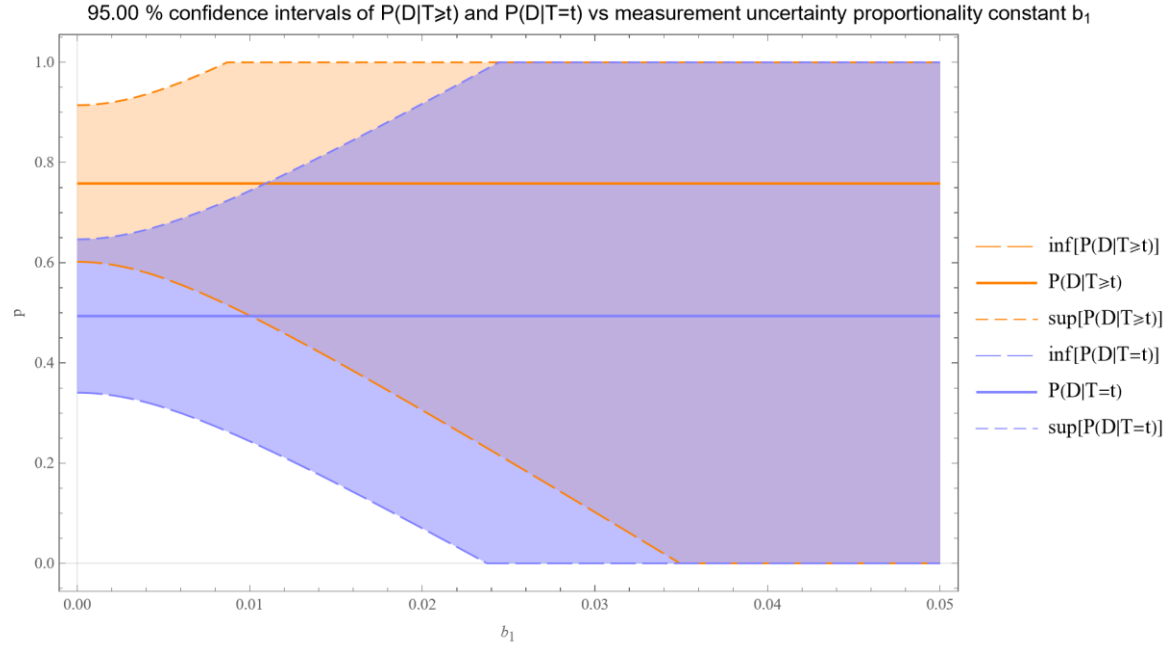

Figure S28, with the parameter settings in Table S6.

4.4.Standard Uncertainty vs Population Sample Size

Table S7

	Figures S29, S31	**Figures S30, S32**	**Figure S33**	**Figure S34**
p	-	-	0.95	0.95
t	126.0	126.0	126.0	126.0
μ_D	120.8	120.8	120.8	120.8
σ_D	17.7	17.7	17.7	17.7
$\mu_{\overline{D}}$	102.6	102.6	102.6	102.6
$\sigma_{\overline{D}}$	10.7	10.7	10.7	10.7
n	$20-20000$	$20-2000$	$20-20000$	$20-2000$
v	0.158	0.158	0.158	0.158
b_0	0.866	0.866	0.866	0.866
b_1	0.0109	0.0109	0.0109	0.0109
n_U	-	-	1350	1350
d_D	lognormal	lognormal	lognormal	lognormal
$d_{\overline{D}}$	lognormal	lognormal	lognormal	lognormal

The parameter settings of the figures S29 - S34

4.4.1. Standard Uncertainty

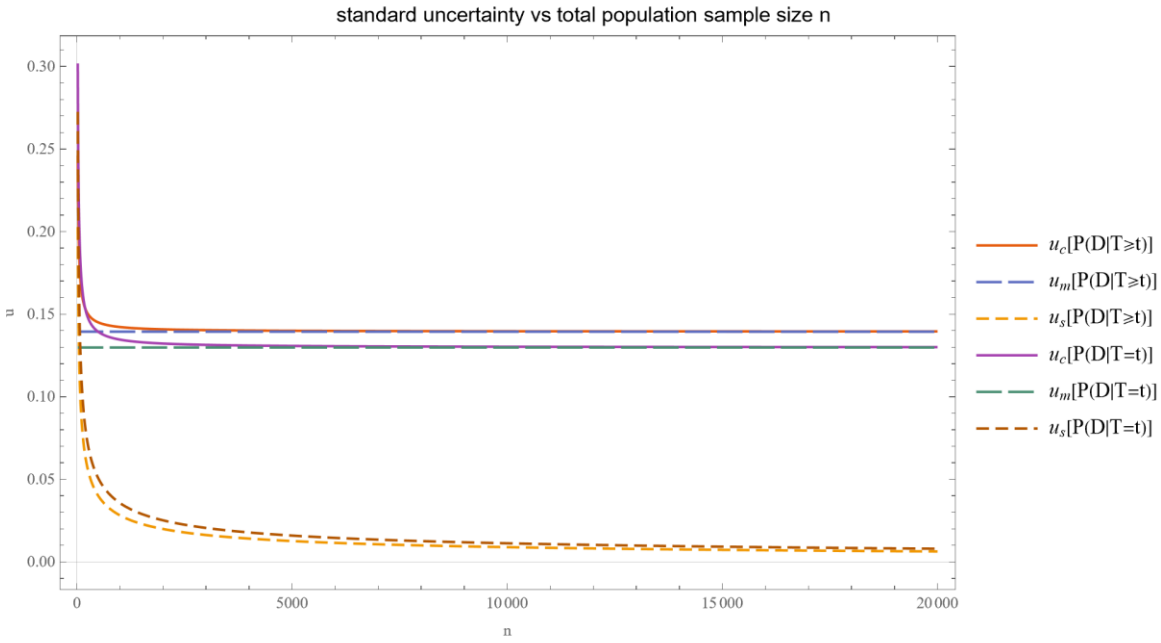

Figure S29, with the parameter settings in Table S7.

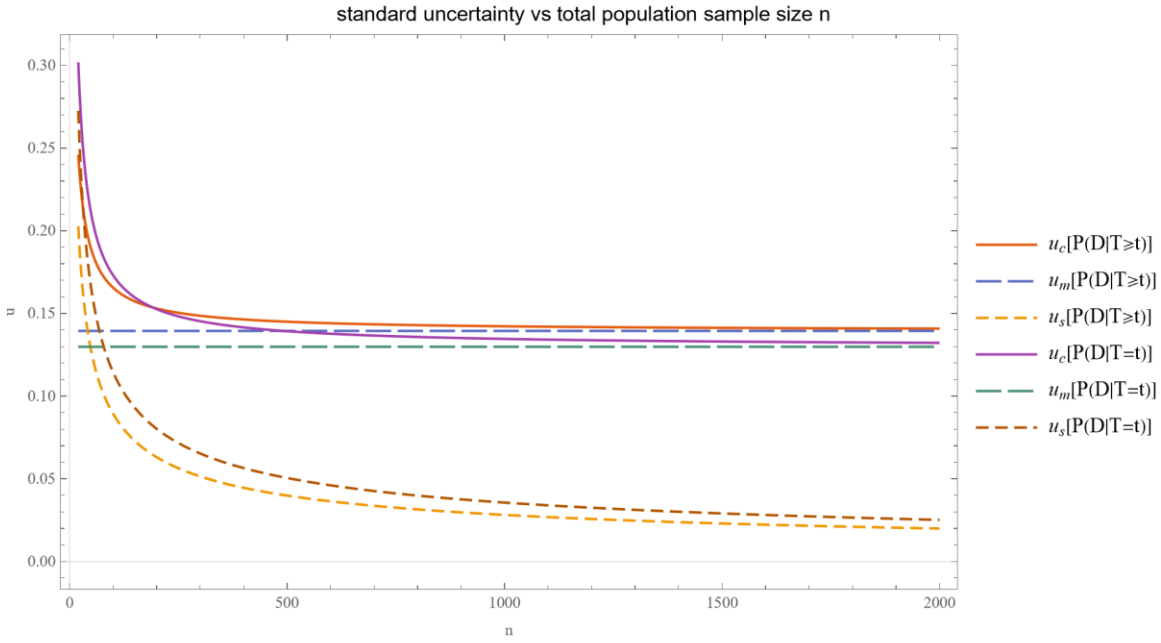

Figure S30, with the parameter settings in Table S7.

4.4.2. Relative Standard Uncertainty

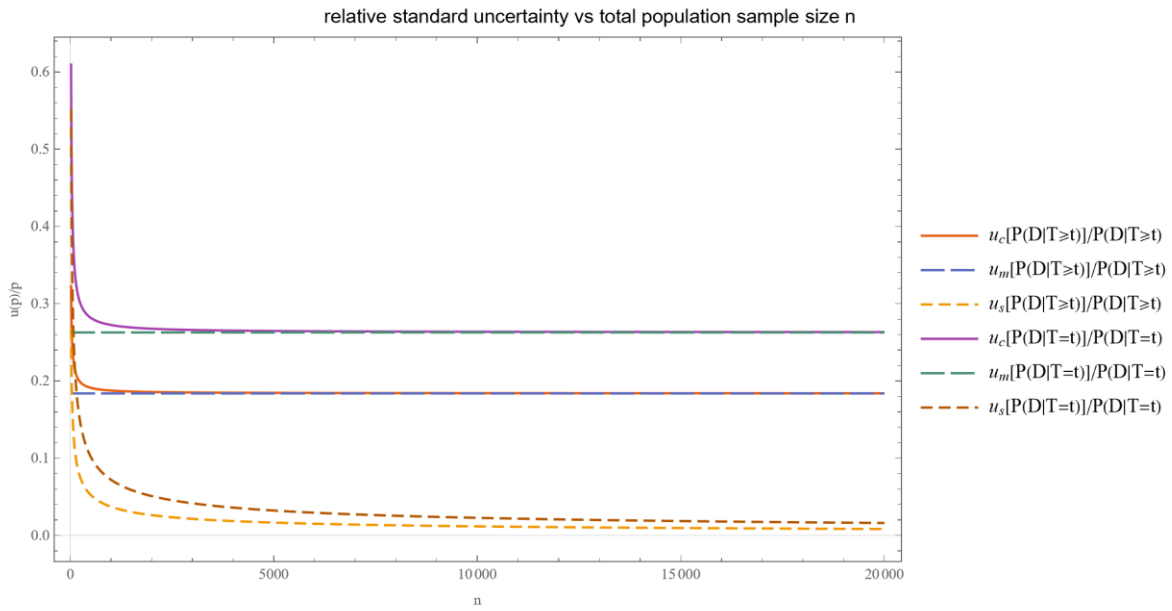

Figure S31, with the parameter settings in Table S7.

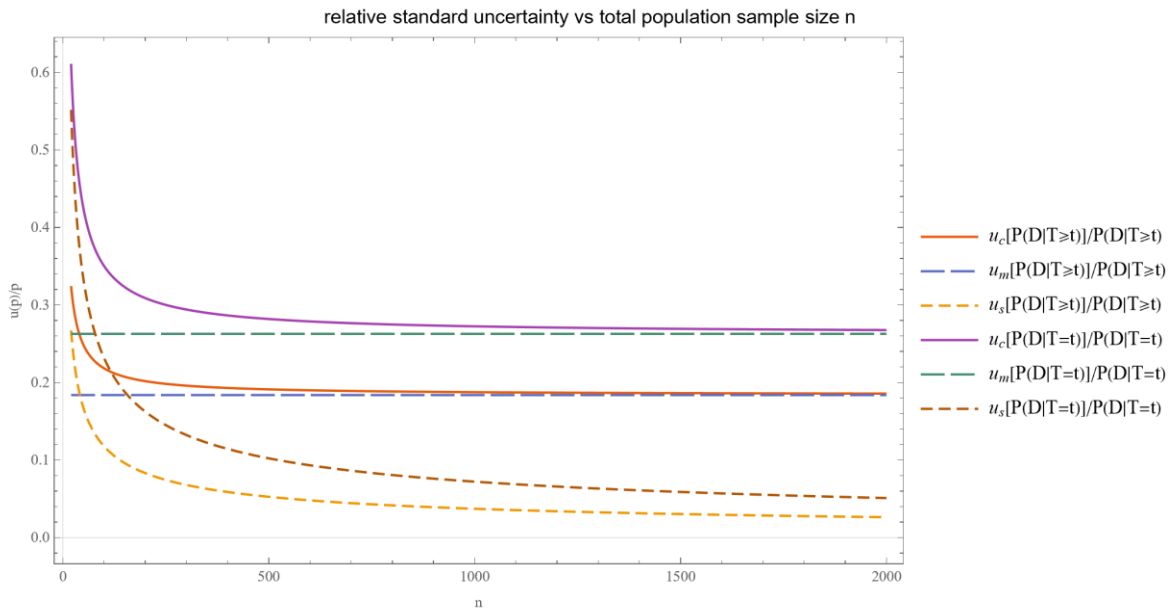

Figure S32, with the parameter settings in Table S7.

4.4.4. Confidence Intervals

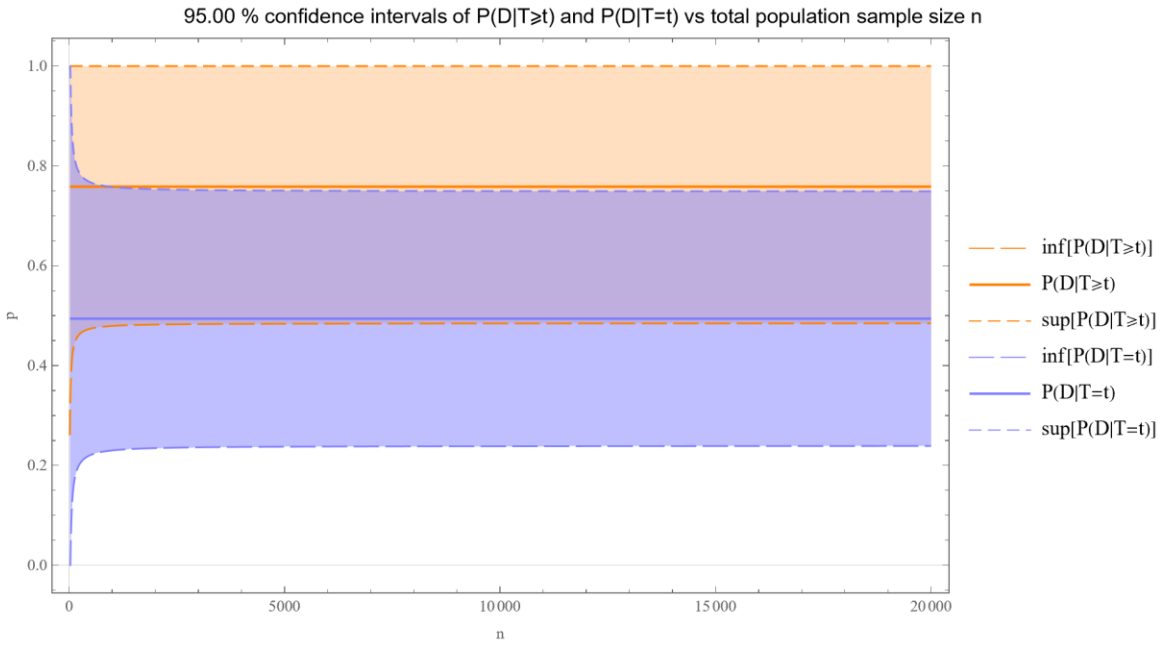

Figure S33, with the parameter settings in Table S7.

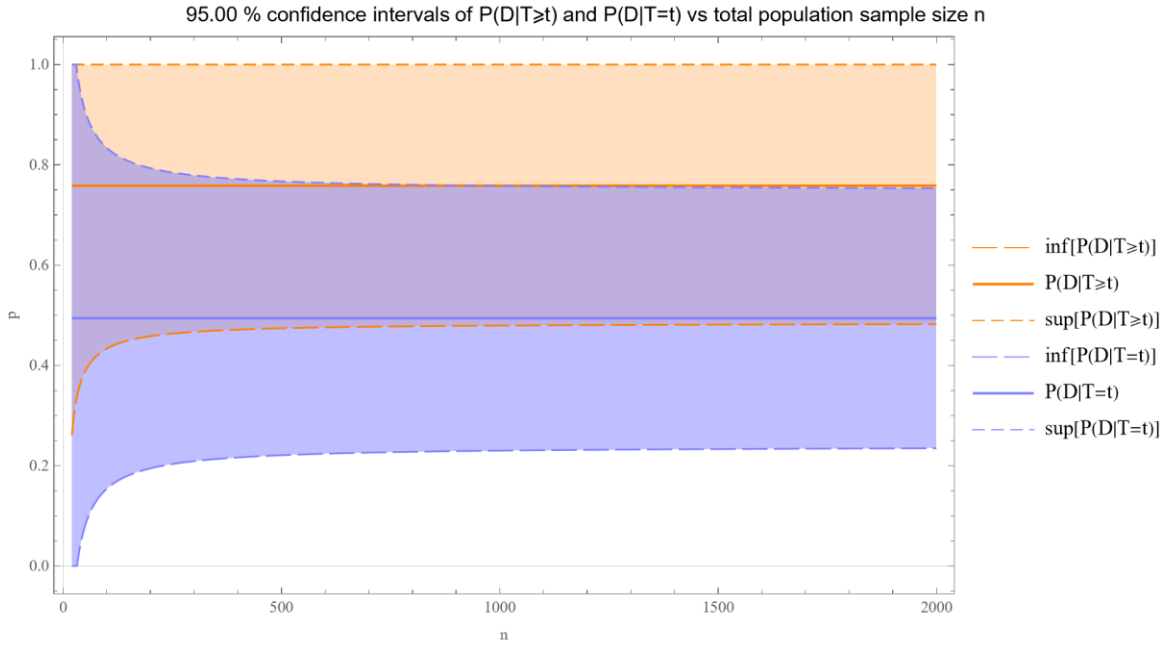

Figure S34, with the parameter settings in Table S7.

4.5.Standard Uncertainty vs prevalence of disease

Table S8

	Figures S35, S37	**Figures S36, S38**	**Figure S39**	**Figure S40**
p	-	-	0.95	0.95
t	126.0	126.0	126.0	126.0
μ_D	120.8	120.8	120.8	120.8
σ_D	17.7	17.7	17.7	17.7
n_D	154	154	154	154
$\mu_{\overline{D}}$	102.6	102.6	102.6	102.6
$\sigma_{\overline{D}}$	10.7	10.7	10.7	10.7
$n_{\overline{D}}$	822	822	822	822
v	$0.001 - 0.999$	$0.001 - 0.200$	$0.001 - 0.999$	$0.001 - 0.200$
b_0	0.866	0.866	0.866	0.866
b_1	0.0109	0.0109	0.0109	0.0109
n_U	-	-	1350	1350
d_D	lognormal	lognormal	lognormal	lognormal
$d_{\overline{D}}$	lognormal	lognormal	lognormal	lognormal

The parameter settings of the figures S35 - S40

4.5.1. Standard Uncertainty

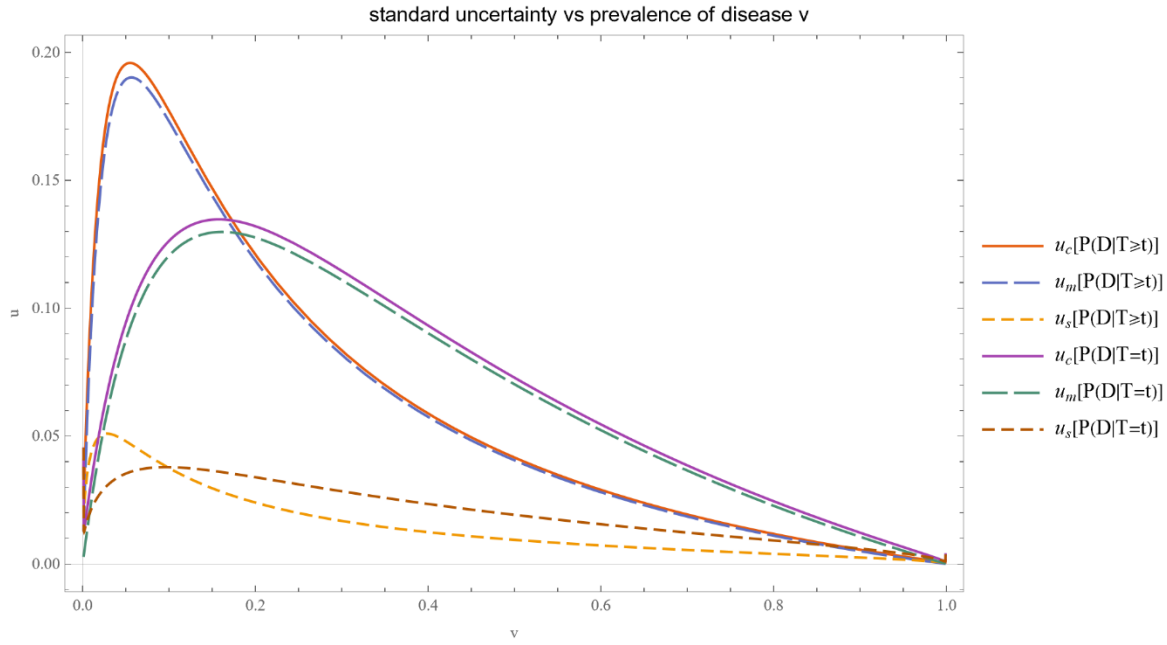

Figure S35, with the parameter settings in Table S8.

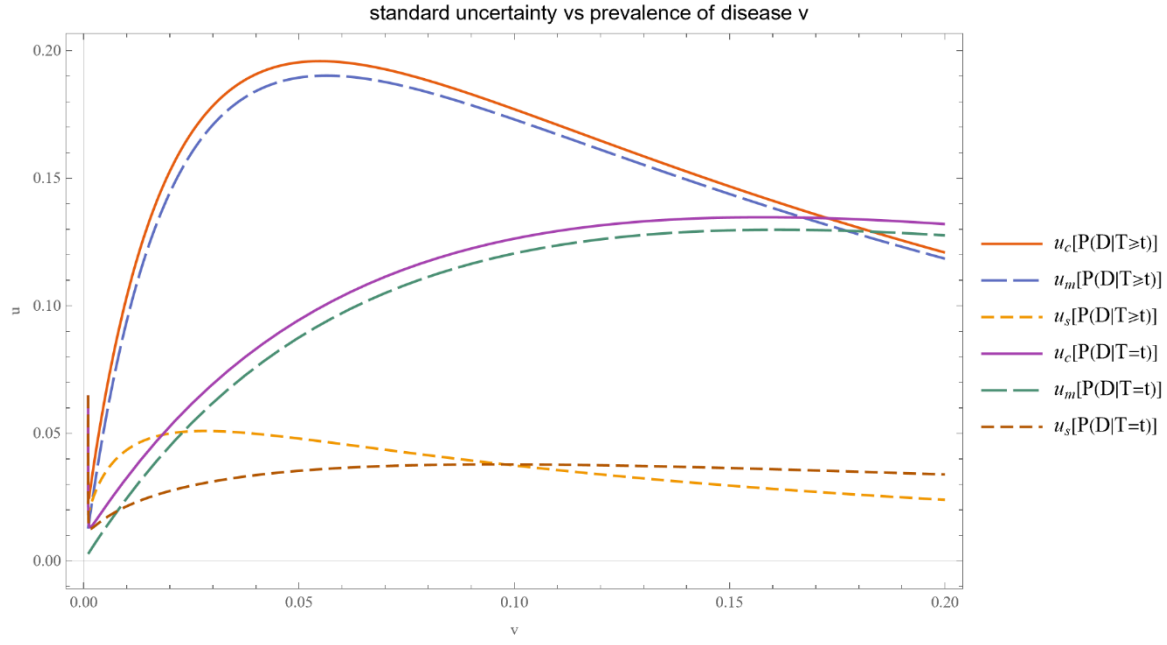

Figure S36, with the parameter settings in Table S8.

4.5.2. Relative Standard Uncertainty

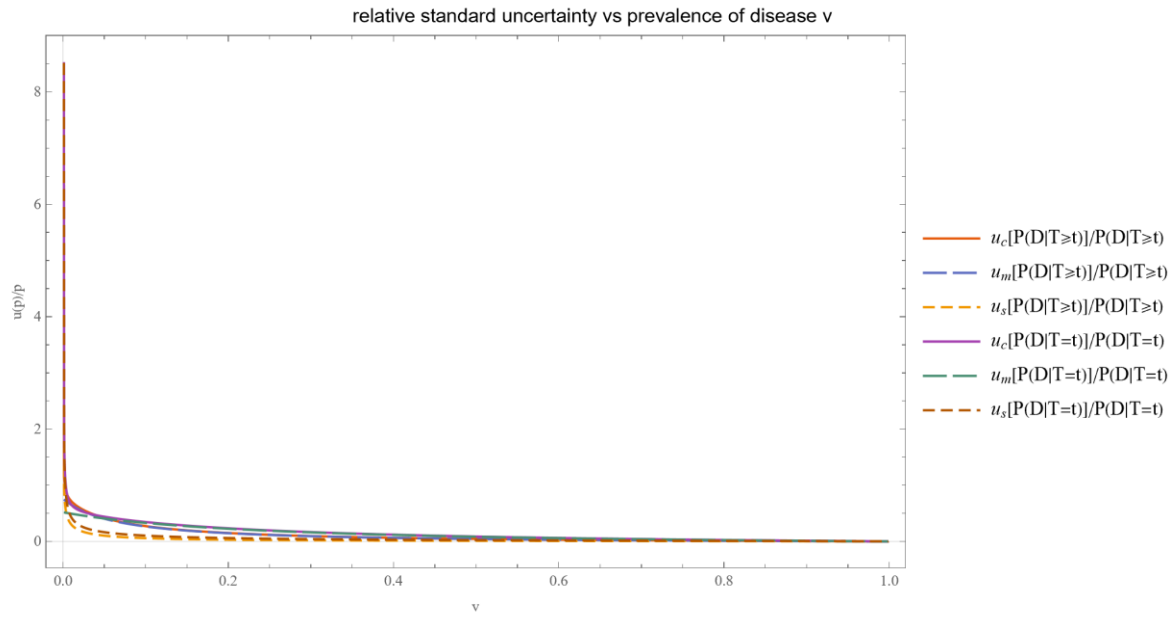

Figure S37, with the parameter settings in Table S8.

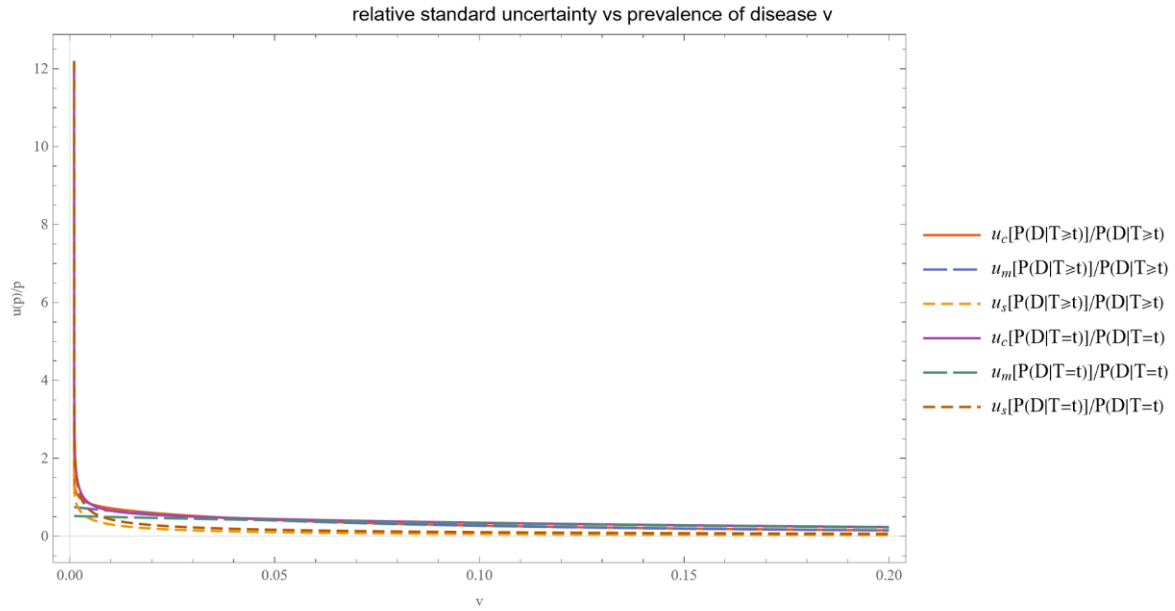

Figure S38, with the parameter settings in Table S8.

4.5.3. Confidence Intervals

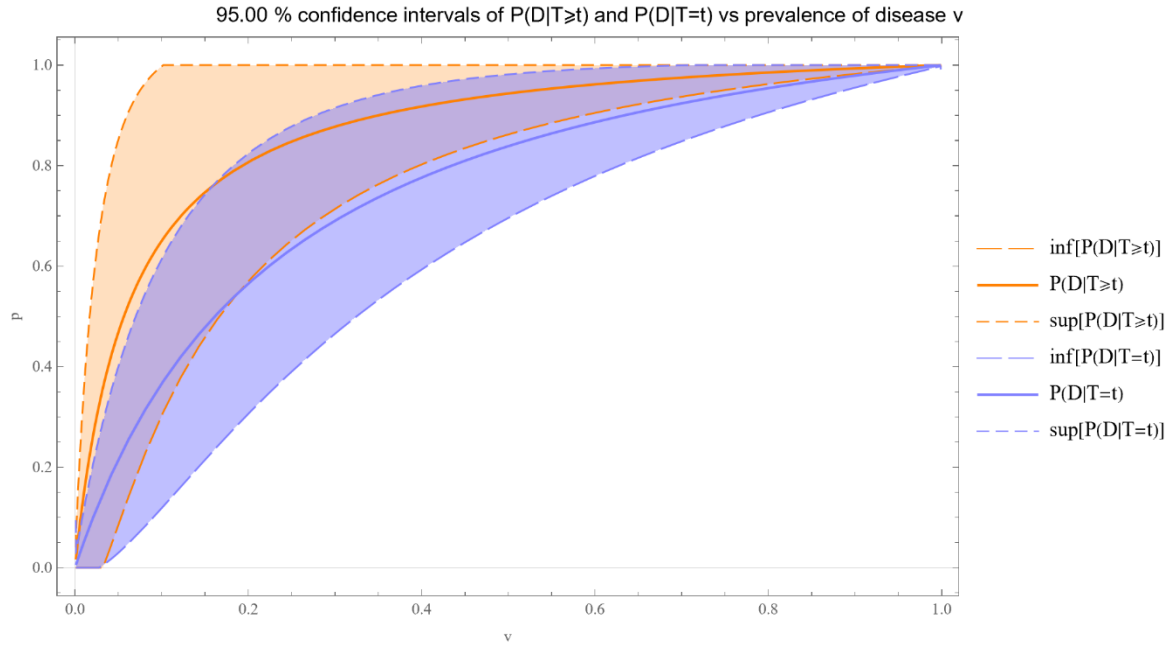

Figure S39, with the parameter settings in Table S8.

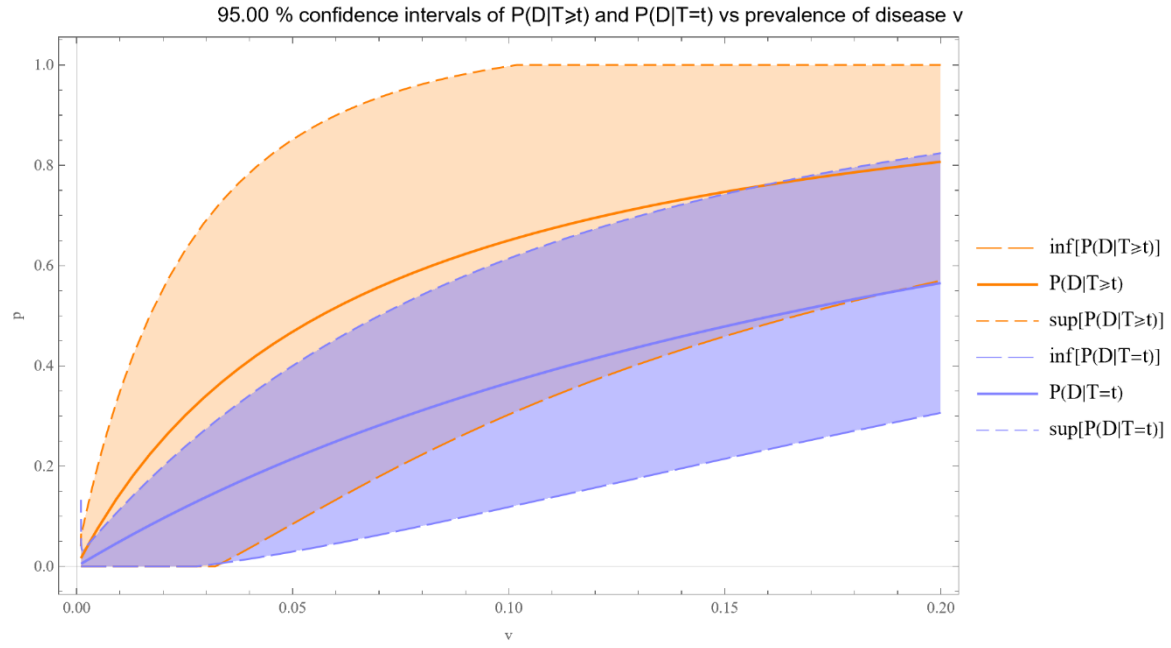

Figure S40, with the parameter settings in Table S8.

5. Standard Uncertainty Tables for All Parametric Distributions

Table S9

	Figures S41 - S44	**Figures S45, S46**
p	-	0.95
t	126.0	126.0
μ_D	120.8	120.8
σ_D	17.7	17.7
n_D	154	154
$\mu_{\overline{D}}$	102.6	102.6
$\sigma_{\overline{D}}$	10.7	10.7
$n_{\overline{D}}$	822	822
V	0.158	0.158
b_0	0.866	0.866
b_1	0.0109	0.0109
n_U	-	1350
d_D	normal lognormal gamma	normal lognormal gamma
$d_{\overline{D}}$	normal lognormal gamma	normal lognormal gamma

The parameter settings of the figures S41 - S46

5.1.Standard Uncertainty

standard uncertainty of P(D|T≥t)					
prevalence of disease = 0.158					
measurand distribution		point estimation	standard uncertainty		
diseased	nondiseased		combined	measurement	sampling
normal	normal	0.833	0.132	0.130	0.025
	lognormal	0.771	0.137	0.134	0.027
	gamma	0.790	0.138	0.135	0.027
lognormal	normal	0.823	0.138	0.136	0.027
	lognormal	0.758	0.142	0.140	0.029
	gamma	0.778	0.143	0.140	0.028
gamma	normal	0.826	0.136	0.134	0.026
	lognormal	0.763	0.141	0.138	0.028
	gamma	0.892	0.007	0.005	0.005

Figure S41, with the parameter settings in Table S9.

standard uncertainty of P(D|T=t)					
prevalence of disease = 0.158					
measurand distribution		point estimation	standard uncertainty		
diseased	nondiseased		combined	measurement	sampling
normal	normal	0.542	0.171	0.166	0.040
	lognormal	0.509	0.134	0.129	0.035
	gamma	0.516	0.145	0.141	0.036
lognormal	normal	0.527	0.135	0.130	0.036
	lognormal	0.494	0.135	0.130	0.036
	gamma	0.501	0.146	0.141	0.037
gamma	normal	0.531	0.172	0.167	0.040
	lognormal	0.498	0.135	0.130	0.036
	gamma	0.505	0.146	0.141	0.037

Figure S42, with the parameter settings in Table S9.

5.2.Relative Standard Uncertainty

relative standard uncertainty of P(D|T≥t)					
prevalence of disease = 0.158					
measurand distribution		point estimation	relative standard uncertainty		
diseased	nondiseased		combined	measurement	sampling
normal	normal	0.833	0.159	0.156	0.031
	lognormal	0.771	0.178	0.174	0.036
	gamma	0.790	0.174	0.171	0.034
lognormal	normal	0.823	0.168	0.165	0.032
	lognormal	0.758	0.188	0.184	0.038
	gamma	0.778	0.184	0.180	0.036
gamma	normal	0.826	0.165	0.162	0.032
	lognormal	0.763	0.184	0.181	0.037
	gamma	0.892	0.008	0.006	0.005

Figure S43, with the parameter settings in Table S9.

relative standard uncertainty of P(D|T=t)					
prevalence of disease = 0.158					
measurand distribution		point estimation	relative standard uncertainty		
diseased	nondiseased		combined	measurement	sampling
normal	normal	0.542	0.315	0.306	0.073
	lognormal	0.509	0.264	0.254	0.069
	gamma	0.516	0.282	0.273	0.071
lognormal	normal	0.527	0.256	0.246	0.068
	lognormal	0.494	0.273	0.263	0.073
	gamma	0.501	0.291	0.282	0.075
gamma	normal	0.531	0.323	0.314	0.076
	lognormal	0.498	0.270	0.261	0.072
	gamma	0.505	0.289	0.279	0.073

Figure S44, with the parameter settings in Table S9.

5.3.Confidence Intervals

95.00% confidence intervals of P(D|T≥t)				
prevalence of disease = 0.158				
diseased	nondiseased	point estimation	lower bound	upper bound
normal	normal	0.833	0.574	1.000
	lognormal	0.771	0.501	1.000
	gamma	0.790	0.520	1.000
lognormal	normal	0.823	0.552	1.000
	lognormal	0.758	0.479	1.000
	gamma	0.778	0.497	1.000
gamma	normal	0.826	0.559	1.000
	lognormal	0.763	0.487	1.000
	gamma	0.892	0.878	0.906

Figure S45, with the parameter settings in Table S9.

95.00% confidence intervals of P(D|T=t)				
prevalence of disease = 0.158				
diseased	nondiseased	point estimation	lower bound	upper bound
normal	normal	0.542	0.207	0.877
	lognormal	0.509	0.246	0.772
	gamma	0.516	0.231	0.801
lognormal	normal	0.527	0.263	0.791
	lognormal	0.494	0.229	0.758
	gamma	0.501	0.215	0.787
gamma	normal	0.531	0.195	0.868
	lognormal	0.498	0.234	0.762
	gamma	0.505	0.219	0.791

Figure S46, with the parameter settings in Table S9.

6. Standard Uncertainty Tables for All Diagnostic Measures

Table S10

	Figures S47, S48	**Figure S49**
p	-	0.95
t	126.0	126.0
μ_D	120.8	120.8
σ_D	17.7	17.7
n_D	154	154
$\mu_{\overline{D}}$	102.6	102.6
$\sigma_{\overline{D}}$	10.7	10.7
$n_{\overline{D}}$	822	822
v	0.158	0.158
b_0	0.866	0.866
b_1	0.0109	0.0109
n_U	-	1350
d_D	lognormal	lognormal
$d_{\overline{D}}$	lognormal	lognormal

The parameter settings of the figures S47 - S49

6.1.Standard Uncertainty

standard uncertainty				
prevalence of disease = 0.158				
measure	point estimation	standard uncertainty		
		combined	measurement	sampling
P(D|T≥t)	0.758	0.142	0.140	0.029
P(D|T=t)	0.494	0.135	0.130	0.036

Figure S47, with the parameter settings in Table S10.

6.2.Relative Standard Uncertainty

relative standard uncertainty				
prevalence of disease = 0.158				
measure	point estimation	relative standard uncertainty		
		combined	measurement	sampling
P(D|T≥t)	0.758	0.188	0.184	0.038
P(D|T=t)	0.494	0.273	0.263	0.073

Figure S48, with the parameter settings in Table S10.

6.3.Confidence Intervals

95.00% confidence intervals			
prevalence of disease = 0.158			
measure	point estimation	lower bound	upper bound
P(D|T≥t)	0.758	0.479	1.000
P(D|T=t)	0.494	0.229	0.758

Figure S49, with the parameter settings in Table S10.

7. Notation

7.1.Abbreviations

D: Disease

$\overline{D}$: Absence of disease

T: diagnostic test

7.2.Parameters

t: diagnostic threshold

n_D : size of diseased population

μ_D: mean of diseased population

σ_D: standard deviation of diseased population

d_D: distribution of diseased population

$n_{\overline{D}}$: size of nondiseased population

$\mu_{\overline{D}}$: mean of nondiseased population

$\sigma_{\overline{D}}$: standard deviation of nondiseased population

$d_{\overline{D}}$: distribution of nondiseased population

v : prior probability for disease (prevalence rate)

n_U : number of quality control measurements

b_0 : constant contribution to measurement uncertainty

b_1: measurement uncertainty proportionality constant

p : confidence level

7.3.Bayesian Diagnostic Measures

$P(D|T > t)$: positive predictive value

$P(D|T = t)$: posterior probability for disease

7.4.Functions

$u_m(x)$: standard measurement uncertainty

$u_s(x)$: standard sampling uncertainty

$u_c(x)$: standard combined uncertainty

8. Permanent Citation

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