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**OBS! Läs noga igenom anvisningarna i tentamen, t.ex. hur du ska skriva svaren.  
Det är ditt ansvar som student att följa de anvisningar som ges.**

**NOTE! Read the examination instructions carefully, e.g. how to write the answers.  
It is your responsibility as a student to follow the given instructions.**

Skriv din anonymiseringskod och dagens datum på allt material du lämnar in.  
(Enter your anonymization code and today's date on all submitted materials)

Anonymiseringskod (Anonymization code)	3	1	1	-	0	0	0	1	-	H	M	L
Datum (Date YYYY-MM-DD)	2023-06-01							Plats nr. (Seat No.)	123			

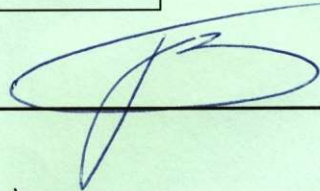
Kurs/Kurskod (Course/Course code)	ST8501
Kursmoment (Course component)	Theory and Methodology of Statistical Science

Fylls i av tentamensvärd (To be filled in by invigilator)

Direkt i skrivning: (kryss)		Svarsblankett: (kryss)		Lösa svarsblad: (antal)	
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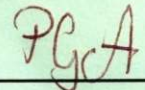
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Inlämningstid: 17:48

Signatur tentamensvärd: 

Fylls i av lärare/examinator (To be filled in by teacher/examinator)

Betyg:	A	Poäng:	Ass.1 Ass.2 30+30+30=90
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Signatur rättande lärare/examinator: 



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A student is responsible for following the instructions.  
You will find the examination instructions carefully and how to write the answers.  
Do not bring any material, not even a calculator, to the exam.  
Get the program from the examination system, but do not bring it with you.

(Enter your identification code and today's date on all submitted materials)  
Skiv din skrivarens utskrift och bägare utrum av alla material du lämnar in.

År	1	1	0	0	1	1	1	1	1
Examinationskod	111-001-1111								
Plats	111								
Kurskod	1111-001								
Kursnamn	1111-001								

(What type of material is to be filled in by invigilator)

Examinationskod	Examinationskod	Examinationskod
Examinationskod	Examinationskod	Examinationskod

Signaturentens namn: 1111

(This is to be filled in by teacher/examiner)

poäng	A	poäng	30+30+30=90
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1111

Signaturentens namn



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The concept of objectivity is highly related to science in many ways. When it comes to experiments they need to be transparent and replicable. Being objective is a crucial part of science, reviewing and analyzing material, drawing conclusions and conducting objective research.

To view material, observations and drawing conclusions completely objective can be hard in some ways. For example in the discussion when it comes to Bayesian theory one has to bring up the possibility of drawing various conclusions.

Choosing prior can lead to different results, what about subjectivity and being neutral?

So to define the concept it is good to also bring up examples of subjectivity.

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(Task no.)

1

Lärens kommentar:  
(Teacher's note)

Poäng:  
(Points)

3

In the discussion of  
the question what is science?

In the general view one  
does connect science with  
objectivity. As I mentioned  
earlier fully objectivity can be  
hard to achieve in science.

Just for example descriptive statistic  
s can be subjective in some way?  
depending on what you want  
to have in the descriptive part.

This is where intersubjectivity  
comes in which is for  
example subjectivity within  
the study. Empirical studies  
are in a way subjective.

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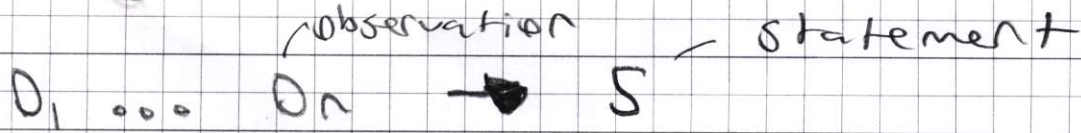
Lärarens  
kommentar:  
(Teacher's  
note)

Poäng:  
(Points)



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Inductive reasoning in science is about going from observations leading to a statement.



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Lärarens kommentar:  
(Teacher's note)

This could be one or several observations that leads to a statement.

Shortcomings?

The connection in this regard of Abduction is about going from general statements (a,b) to making an observed statement seen reasonable.

Poäng:  
(Points)

10/10

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(Task no.)

Lärarens  
kommentar:  
(Teacher's  
note)

Poäng:  
(Points)



## Classical inference theory criticism

One the criticism brought forwards is about how classical inference relies on the way data was obtained so that it is conflict with strong likelihood principle.

The second one is about the frequentist interpretation regarding quality assessment for one particular case.

And lastly is about the consideration of taking the wrong decision in hypothesis testing.

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Lärens kommentar:  
(Teacher's note)

Poäng  
(Points)

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Lärarens  
kommentar:  
(Teacher's  
note)

Poäng:  
(Points)





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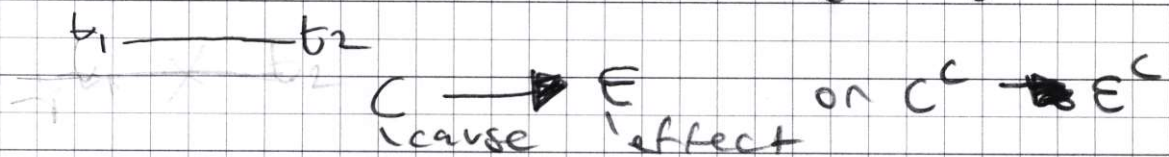
### Fundamental problem of causality

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Lärarens kommentar:  
(Teacher's note)

This is a obstacle common in the world of science. For example in clinical studies we want to try a treatment and our response variable is blood pressure. Let's say we got two groups one gets the treatment the other placebo. The issue here is that we can't give the two different treatments to the same patient at the same time. We want to measure the causal effect of  $E(Y(x_1) - Y(x_2))$



Important issues to take into account

to support a hypothesis of a causal relationship.

1. Determine the time order that the cause comes before the effect
2. Establish that there is correlation
3. High internal validity (no or close non-existing confounders) hidden variables

Poäng:  
(Points)

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Lärarens  
kommentar:  
(Teacher's  
note)

Poäng:  
(Points)



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The Infinite Lottery example is about a lottery where there is an infinite amount of tickets.

With the assumption that lottery should be fair

Definetti claims that it is not possible with the argument that it is in conflict with (3) in Kolmogorov system of axioms.

Why is it in conflict?

$$P\left(\bigcup_{i=1}^{\infty} A_i\right) = \sum P(A_i) = 1.$$

Definetti wanted to show that the construction of an lottery with infinitely many tickets is possible under the assumption that it should be fair.

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Lärarens kommentar:  
(Teacher's note)

Poäng:  
(Points)

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(Task no.)

Lärarens  
kommentar:  
(Teacher's  
note)

Poäng:  
(Points)



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In the situation described in the question we have the following circumstances:

Envelope 1: contains  $b$  monetary units

Envelope 2: contains  $2b$  monetary units

We have drawn one envelope at random and find that it contains  $64$  monetary units.

We do not know which envelope ~~that~~ has been drawn from the two possible envelopes.

Question: If allowed, would we take the other envelope instead?

I will go through the different options and what they entail:

Option 1: Not taking the other envelope and staying with the first one.

Option 2: Taking the other envelope instead

The envelope we are not picking could be containing either  $b$  or  $2b$  monetary units. In this regard

$$\begin{bmatrix} 64 = b \\ 128 = 2b \end{bmatrix} \text{ or } \begin{bmatrix} 32 = b \\ 64 = 2b \end{bmatrix}$$

By option 1 (staying) we could be missing out on picking

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Lärens kommentar:  
(Teacher's note)

Poäng:  
(Points)

6

the envelope containing  $2b$  monetary units given that we have the one with  $b$  monetary units. I will summarize this in a table for simplification.

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Lärarens  
kommentar:  
(Teacher's  
note)

	First drawn envelope = $b$	First drawn envelope = $2b$
OPTION 1	+64	+32
OPTION 2	+64	-32

Because the envelope that is left could be at highest 128 monetary units or lowest 32 monetary units. I would go with option 2 and taking the other envelope.

There is a possibility that the other envelope has 128 monetary units. But if I'm forced to stay I will never get the opportunity to gain 64 monetary units. But with the second option there is a risk of losing 32 monetary units.

Final answer: I would take the other envelope instead.

Poäng:  
(Points)



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We are given the following situation:

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(Task no.)

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parameter  $p$  is of interest  $0 < p < 1$   
 $p$  = probability that for a particular coin will land "heads" when flipped.

Lärens kommentar:  
(Teacher's note)

Experiment 1:  $n = \#$  flipping the coin and recording the amount of times the coin land on "heads"  
 $n = 20$

Experiment 2:  $n = \#$  of tails before the seventh head

The experimenter choose the second one, which means collecting data of the seventh head on trial number 20.

This is two different experiments where the parameter  $p$  is recorded.

From the perspective of the different principles of statistical inference.

one is about the likelihood principle which can be divided into a weak or a strong likelihood principle.

Poäng:  
(Points)

3

next page →

In the first experiment, we

$$Y \sim \text{Bin}(20, \pi)$$

Second experiment  $Z \sim \text{Negbin}(7, \pi)$

$\theta$  which is our parameter that we want to estimate  
Weak likelihood principle

$$\text{lik}(\theta; Y) = h(Y; Y') \cdot \text{lik}(\theta; Y')$$

not dependent on  $\theta$

Strong likelihood principle

$$\text{lik}(\theta; Y) = h(Y; Z) \cdot \text{lik}(\theta; Z)$$

One could argue that the second one (experiment) will not be in conflict with strong likelihood principle. This is a situation at

$$Y = Y_1 \dots Y_n$$

$$Y' = Y_1 \dots \cdot Y_n$$

Other principles?

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Uppg.nr.:  
(Task no.)

Lärarens  
kommentar:  
(Teacher's  
note)

Poäng:  
(Points)



## Regler i skiversion

- Fyll i namnsvens ansvariga
- Vårskrivarens namn ska stå på alla sidor
- Fyll i handlingens syfte på första sidan
- Fyll i studens namn och adress på första sidan
- Fyll i kursens namn på första sidan
- Fyll i kursens innehåll på första sidan
- Fyll i kursens mål på första sidan
- Fyll i kursens utvärdering på första sidan
- Fyll i kursens ansvariga på första sidan
- Fyll i kursens kontaktuppgifter på första sidan
- Fyll i kursens referenslitteratur på första sidan
- Fyll i kursens övriga uppgifter på första sidan

Om du har frågor - så är vi tillgängliga på telefon

## Regler i den examinationen

- Fyll i namnsvens ansvariga
- Vårskrivarens namn ska stå på alla sidor
- Fyll i handlingens syfte på första sidan
- Fyll i studens namn och adress på första sidan
- Fyll i kursens namn på första sidan
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Om du har frågor - så är vi tillgängliga på telefon

## Regler i skrivsalen

- Följ tentamensvärds anvisningar.
- Väskor och ytterkläder ska placeras på anvisad plats.
- Placera ID-handling väl synlig på bordet framför dig.
- Ingen student får lämna skrivsalen under de första 30 minuterna.
- Endast en student i taget får besöka toaletten. Vid toalettbesök skriv ditt namn och klockslag på avsedd lista. Efter toalettbesöket ska du åter ange klockslag på listan.
- Elektronisk utrustning som mobiltelefon eller Smartwatch ska vara avstängd och placerad på anvisad plats.
- Under tentamen gäller tystnad – det är förbjudet att prata, eller på annat sätt kommunicera, med andra studenter under pågående tentamen.
- Innan tentamenshandlingarna lämnas in; skriv sidnummer, anonymiseringskod och datum på alla inlämnade papper.

Om något är oklart – fråga gärna tentamensvärden. Lycka till!

## Rules in the examination hall

- Follow the invigilator's instructions.
- Bags and outerwear must be placed at the designated place.
- Place your ID document clearly visible on the table in front of you.
- No student may leave the examination hall for the first 30 minutes.
- Only one student at a time may visit the toilet. Before visiting the toilet, write your name and time on the intended list. After the toilet visit, enter the time on the list again.
- Electronic equipment such as a mobile phone or Smartwatch must be switched off and placed at the designated place.
- During the exam, silence applies – you are not allowed to talk, or otherwise communicate, with other students during the exam.
- Before submitting the examination documents; remember to write the page number, anonymization code, and date on all papers.

Please do not hesitate to ask the invigilator if anything is unclear. Good luck!