



Stockholms
universitet

**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	-	K	K	R
Datum (Date YYYY-MM-DD)	2023-08-15							Plats nr. (Seat No.)	50			

Kurs/Kurskod (Course/Course code)	ST5501
Kursmoment (Course component)	Theory and Methodology of Statistical Science

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

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Inlämningstid: 15:57

Signatur tentamensvärd:

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

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Tentamen Inl 1 Inl 2
PGA

Signatur rättande lärare/examinator:



7. Carl Popper introduced the concept of falsifiability, if this concept were not fulfilled in a study then it could not be stated as scientific, meant C. Popper. The meaning with falsifiability is that predictions should be able to be compared with observations, so they can be verified and falsified if not the same. C. Popper gave a well known example of non-scientific study when falsifiability criterion was not met, Marx's theory of history. Marx's theory about history are not scientific since Marx changed his thoughts and statements throughout the history as his beliefs were not met. But one important thing to add is that theories have been updated rather than falsified and this has led to new important knowledge gained. In empirical studies we observe subjects and event in the 'real-world' and an example of falsifiability here is for example when predicting 1 out of ^{a sample of} 100 fishes to die, within a year in a lake, but it turns out no one died → your theory about deaths in the lake are falsified, able to be verified but one other important thing to mention is that one observation can falsify a theory but not the other way around.

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Lärarens
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Uppg.nr.:
(Task no.)

Sidnr.:
(Page no.)



Datum: (Date YYYY-MM-DD)	2023-08-15	Kurs/Kurskod: (Course/Course code)	ST3501	Sidnr.: (Page no.)									
Anonymiseringskod (Anonymization code)	3	1	1	-	0	0	0	1	-	K	K	R	8

2. Scientific knowledge is supposed to help us understand the world we live in, to observe, explain and describe. In scientific knowledge it is very important that the study are very detailed, step by step, so it is repeatable. This is an important part of scientific knowledge because the research made must be able to be verified and compared to knowledge already found. A scientist may see him/herself as objective but in fact we are all affected by who we are, where we come from and earlier knowledge (given or found), so it is very important to state our prior opinions even if we do not think it is necessary. We might think that we have been totally objective but it is more or less impossible. By stating our prior opinions we help the next person performing our study to check if these prior ^{opinions} may have inflicted the study and to maybe look at all the steps made in the study with more open eye, and in that way contributing to gaining new additional knowledge.

Uppg.nr.:
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2.

Lärens kommentar:
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Uppg.nr.:
(Task no.)

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(Page no.)



Datum: (Date YYYY-MM-DD)	2023-08-15	Kurs/Kurskod: (Course/Course code)	5T5501	Sidnr.: (Page no.)									
Anonymiseringskod (Anonymization code)	3	1	1	-	0	0	0	1	-	K	K	R	2.

3. Subjective probabilities can interfere the Kolmogorovs axioms of probabilities since they are based on subjective beliefs, prior knowledge along with wishes so here the importance of coherence comes in to the picture, otherwise we might end up with a so called 'Dutch Book'.

Uppg.nr.:
(Task no.)

3.

Lärarens kommentar:
(Teacher's note)

A Dutch Book is when having a number of bets, all being acceptable, but you end up losing every time. This may be the case when $P(A \cup B) < P(A) + P(B)$, violating Kolmogorovs axiom 3. For example say you bet on even A and B and buy them for $P(A) + P(B)$ utility units and that you then sell a bet on $A \cup B$ for $P(A \cup B)$ utility units, you then lose since $P(A) + P(B) - P(A \cup B) > 0$, you haven't gained anything.

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Lärares
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Uppg.nr.:
(Task no.)

Sidnr.:
(Page no.)



Datum: (Date YYYY-MM-DD)	2023-08-15	Kurs/Kurskod: (Course/Course code)	ST5501	Sidnr.: (Page no.)									
Anonymiseringskod (Anonymization code)	3	1	1	-	0	0	0	1	-	K	K	R	3

4. Empiricism emphasize the importance of data-driven conclusions, observations and experiments are here based on real-world data while Rationalism use logic, reasoning and deduction to come to conclusions.

Uppg.nr.:
(Task no.)

4.

Lärens kommentar:
(Teacher's note)

Empiricism can be good in the way that it reduces the risk of errors made by theoretical assumptions but at the same time the quality and quantity of the available data are very important here, while for rationalism it is not because here the theory assumptions made from logic and reasoning are more important but if these assumptions are flawed then the conclusions might turn out quite wrong. So a balance and communication between empiricism and rationalism is most often to prefer, I would say, and if taking one of them in to higher account I think it should be stated and argued why.

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Uppg.nr.:
(Task no.)

Sidnr.:
(Page no.)



Datum: (Date YYYY-MM-DD)	2023-08-15	Kurs/Kurskod: (Course/Course code)	ST5501	Sidnr.: (Page no.)									
Anonymiseringskod (Anonymization code)	3	1	1	-	0	0	0	1	-	K	K	R	4

5. Causality in terms of David Hume's definition:

"If one event, the cause, occurs, then the other event, the effect, occurs and if the effect never had happened, then so would not the cause."

... Something like that"

This is a very deterministic way of looking at causality and a problem with this way of seeing it is, based on this definition, that war does not cause death since there are people surviving the war. To be able to use this deterministic view on causality we need to include a lot of other premises that together with war for this example causes death as an effect, but it is hard, if not impossible to state all these, together with a random effect.

Uppg.nr.:
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5.

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Uppg.nr.:
(Task no.)

Sidnr.:
(Page no.)



Datum: (Date YYYY-MM-DD)	2023-08-11	Kurs/Kurskod: (Course/Course code)	ST5501	Sidnr.: (Page no.)									
Anonymiseringskod (Anonymization code)	3	1	1	-	0	0	0	1	-	K	K	R	5

6. Confounding variables are variables affecting a correlation between other variables. For example when analyzing if there are a causal relationship between two variables, we might have found a correlation between them and been able to make sure that the cause comes before the effect but in the end it turns out that it was one or more other variables influencing these two variables analyzed for causality, they do not have a causal relationship, all is because of the confounding variables. One want to ensure that confounders are eliminated when checking causality, also mentioned as internal validity, and these sort of variables/factors can be divided into two groups, Extrinsic and Intrinsic factors. Extrinsic factors are factors caused by the process of selection, most common when the participation is voluntary, the study for causal relationship may then be violated due to the selection of participants. Intrinsic factors are factors (förändring) being there while the study is under process, for example when trying to see a causal relationship between a campaign and sales going up, for a product. We might here think we have found a causal relationship since we see the sale going up, but this effect may be because of intrinsic factors, like for example a influencer promoting the product, or something like that.

Uppg.nr.:
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Uppg.nr.:
(Task no.)

Sidnr.:
(Page no.)



Datum: (Date YYYY-MM-DD)	2023-08-15	Kurs/Kurskod: (Course/Course code)	ST5501	Sidnr.: (Page no.)									
Anonymiseringskod (Anonymization code)	3	1	1	-	0	0	0	1	-	K	R	R	6

7. Occam's principle is that the theory with fewest assumptions should be selected. Occam means that the world is simple and that with a too complex model with a lot of parameters loses the importance with a model, to explain, and in some way this can sound realistic since we have learned and seen that a too complex model can lead to overfitting the data and not explaining/describing the trend we are looking for. But at the same time there are no, or only a little, empirical evidence on that the world would be 'simple'... how simple?

Uppg.nr.:
(Task no.)

7

Lärarens kommentar:
(Teacher's note)

There is nothing telling us that we do not also lose important information when simplifying the model. When interpreting a model and adding/removing parameters it can be very hard to be sure that the 'simplest model found' are the correct one, it might show in significance and so on but how can we be sure that it describe what we really are wanting to study, that there are no cofounders in the background and that the parameters eliminated are eliminated for the right reasons or may we just have matched them with other parameters that might be "in conflict" with them?

Example?

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Uppg.nr.:
(Task no.)

Sidnr.:
(Page no.)



Datum: (Date YYYY-MM-DD)	2023-08-15	Kurs/Kurskod: (Course/Course code)	ST5501	Sidnr: (Page no.)									
Anonymiseringskod (Anonymization code)	3	1	1	-	0	0	0	1	-	K	K	R	7

8. A model is supposed to describe something under study. If we want to draw conclusions about inference or some other sort of study we want to be able to test different parameters in the model and get different descriptions so we in the end can determine which parameter gives the best model, if we get the same descriptions when having different parameters it is impossible to decide which one is the best one for the data. For a model to be identified, it must give different results when different parameters, this can be defined like following:

Uppg.nr.:
(Task no.)

8.

Lärarens kommentar:
(Teacher's note)

If we say that we have a random vector Y , and $F_Y(Y|\theta)$ is the joint distribution for Y over a parameter vector θ . Then for any $\theta_1 \in \Theta$ and $\theta_2 \in \Theta$, $\theta_1 \neq \theta_2$ we get $F_Y(Y|\theta_1) \neq F_Y(Y|\theta_2)$ for some Y , if this statement holds then θ is identified and if θ is identified then so is the model, in other words that the model gets different outcomes/descriptions with different parameters.

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Uppg.nr.:
(Task no.)

Sidnr.:
(Page no.)



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!

Regler i skrivsalen

- Följ tentamensvårds 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 tentamensvården. Lycka till!!!