



# 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)					-	0	0	0	2	-	4	3	2
Datum (Date YYYY-MM-DD)	20220815							Plats nr. (Seat No.)			20		

Kurs/Kurskod (Course/Course code)	ST5501
Kursmoment (Course component)	STATISTISK VEETENSKAPSTEOORI o METOD

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

Direkt i skrivning: (kryss)		Svarsblankett: (kryss)		Lösa svarsblad: (antal)	4
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Lämnat in blankt: (kryss)		Dator: (kryss)	
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Inlämningstid: 10 : 00

Signatur tentamensvärd: Pirskan von Gegerfeldt

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

Betyg:	D	Poäng:	26+20+18=64
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Signatur rättande lärare/examinator: JW





Datum: (Date YYYY-MM-DD)	2022-08-15	Kurs/Kurskod: (Course/Course code)	ST5501	Sidnr.: (Page no.)	1
Anonymiseringskod (Anonymization code)	- 0 0 0 2 - 4 3 2				

<p>Episteme utgör teoretisk kunskap, t. ex att kunna beräkna den kraft som krävs för att utföra ett visst danssteg, eller för att beräkna hållfastheten på en bro. Technique utgörs av praktisk kunskap, t. ex en ballerina som utför de så kallade 'pointe' som ingår i den svarta svanens solo. I modern tid tenderar episteme och technique att vävas ihop i varandra, där ren hantverkskunskap stöds och utförs av en teoretisk förståelse, och samtidigt så ökas den teoretiska förståelsen genom praktisk tillämpning. Både episteme och technique innebär specialiserade och fördjupade kunskaper för att beakta, men kan kräva helt olika förmågor och egenskaper hos individen. Detta då episteme kan vara abstrakt och svåröverskådligt, medan technique kan kräva en repetition, viss motorik etc.</p>	Uppg.nr.: (Task no.) 1	Lärarens kommentar: (Teacher's note)
		Poäng: (Points) 5

En teori är falsifierbar om det går att visa att den är inkorrekt. T.ex om vi har en teori som säger att i en familj med två föräldrar kommer den förälder som har lägst lön att ta störst ansvar för hushållsarbete och barn. Den är falsifierbar och visas vara fel om det finns familjer där den person som har högst inkomst även tar störst ansvar för barn och barn. (Föräldrar håller teorin i de fall man tjänar mest men inte de kvinnan tjänar mest)

Uppg.nr.:  
(Task no.)

2

Lärarens  
kommentar:  
(Teacher's  
note)

Om det finns  
observerbara  
som falsifierar  
teori - måste man  
ge ett den -  
Teori som gäller  
bara ibland är  
inte vetenskapligt  
:-)

Poäng:  
(Points)

3



Datum: (Date YYYY-MM-DD) 2022 08 15	Kurs/Kurskod: (Course/Course code)	Sidnr.: (Page no.)
Anonymiseringskod (Anonymization code)	- 0 0 0 2 - H 7 2	2

Den teori som en studie/experiment utgår från sätter ramen för vilka observationer som anses vara relevanta. Om vi vill veta varför en del personer som isjuktade: COVID har fått ett hälsoproblem månader efter infektionen och tror att det har genetiska orsaker så kommer vi förmodligen inte kartlägga kost eller motion varor. Detta gör att mängden information i form av observationer blir mer hanterbar, men kan även bidra till en bristfällig eller direkt felaktig förståelse för fenomenet. Ta t.ex. att det i västvärlden finns en idé om att kvinnor är sämre på matte och därför inte söker sig till yrken inom STEM. Detta stöder till viss mån av bebygg etc. Samtidigt kan man se att i länder där det inte finns en sådan kulturell förståelse är andelen kvinnor inom STEM ungefär samma som män. Vi vet även att de förväntningar som finns på en person (eller grupp) påverkar resultat. Det finns därmed skäl att tro att den låga andelen kvinnor inom STEM i väst beror mer på förväntningar än att kvinnor är mindre på matte.

Uppg.nr.: (Task no.)	3
Lärarens kommentar: (Teacher's note)	
Poäng: (Points)	5

Sannolikheter som propensity innebär att om ett försök skulle upprepas ett oändligt antal gånger så går den relativa frekvensen för en händelse mot sannolikheten. Man sannolikheten för att få ett udda nummer med en vanlig tärning är 0.5. Av detta följer att om vi kastar en tärning oändligt många gånger så kommer vi få ett udda nummer hälften av gångerna.

Detta är ett objektiva mått på sannolikheter, eftersom det grundas i (teoretiskt) observerbara utfall.

Uppg.nr:  
(Task no.)

4

Lärares  
kommentar:  
(Teacher's  
note)

✓  
Detta är  
frekvens l.k.  
Helt rätt  
Propansitivitet  
är ansvarande  
(en implikation  
samma analysen  
Så för frekvens  
följning).

Poäng:  
(Points)

0



Förklar

Ett experiment är ett försök att under kontrollerade former göra vissa observationer. Idealt är om experimentet kan utföras på ett sådant sätt att det inte finns några utomstående faktorer att ta hänsyn till (Detta är dock svårt när man har med t. ex. människor att göra). Ett experiment bör även gå att upprepa. ok

Det finns vissa svårigheter att experimentellt studera kausala samband eftersom samma individ inte t. ex. kan få två behandlingar samtidigt. Detta kan hanteras antingen genom antagandet att det inte görs någon skillnad om händelse 1 sker vid  $t_1$  och händelse 2 sker vid  $t_2$ , eller genom att man antar att olika individer reagerar på samma sätt. Så att en grupp får behandling och en annan grupp utgör kontroll grupp.

# Poissons postulater

Uppg.nr.:  
(Task no.)

6

Lärens  
kommentar:  
(Teacher's  
note)

- 1/ Antalet händelser i intervallet  $(t_1, t_2)$  skrivet som  $N_2 - N_1$  är stokastiskt oberoende från antalet händelser  $N_1$ , givet  $t_1 < t_2$
- 2/ Antalet händelser i intervallet  $(t_3, t_4)$  är oberoende som  $N_4 - N_3$  är stokastiskt oberoende av antalet händelser i ett tidigare intervall som ej överlappar, så som antalet händelser  $N_2 - N_1$  om  $t_1 < t_2 < t_3 < t_4$
- 3/ Sannolikheten att fler än en händelse sker i ett litet tidsintervall  $\tau$  är av ordningen  $O(\tau)$  och väldigt nära noll.

(Om varje litet tidsintervall  $\tau$  innehåller en eller ingen händelse. Eftersom antalet händelser i varje  $\tau_i$  utgör ett följande intervall som inte överlappar är stokastiska oberoende har tidpunkterna en poissonobservationens utmärkt betydelse.

or

Poäng:  
(Points)

5





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Friedman verkar ha haft otur och bera ränt på dåliga samhällsvetenskaperna... Mer seriöst så är det en viktig varning att kontrollera att nödvändiga antaganden om en modell håller, eftersom modeller annars inte säger något om data-materialet. Detta gäller givetvis inte bara vid regressionsanalys utan vid alla former av statistisk analys där det finns vissa antaganden om t.ex. fördelning, homoskedastisitet, stabilitet osv.

Eftersom det är en grundläggande del i vetenskaplig metod att observationer och analys görs inom ett rigoröst regelverk för att säkerställa både transparens och validitet, så kan det ses som direkt ovetenskapligt att presentera resultat som baseras på en analys där data materialet inte uppfyller de antaganden som krävs för modellens giltighet. Analys och modell måste anpassas efter data materialet om inte data materialet har anpassats till modellen genom t.ex. en transformering.

Tekniken för att göra en del av analysen är inte det problem som Friedman för fram (-2P)

Uppg.nr.:  
(Task no.)  
**7**  
  
Lärarens kommentar:  
(Teacher's note)

Poäng:  
(Points)  
**5**

Tyvärr är det kanske till viss mån akademins eget fel att man hellre publicera resultat baserade på en konstant analys, eftersom studier där man inte kunnat visa något sällan publiceras. På ett sätt kan det såhär förstås en att det på gatan inte vore vara särskilt produktivt att ett forskarlag lagt ned och resurser på studera något bara för att sedan visa löslighet från tillfälliga och konstliga resultat. Men samtidigt innebär detta en risk för att felaktiga antaganden propageras (Alternativt att felet upptäcks och hela disciplinen för det istället ryddas som ovetenskaplig).

Utvärdera diskussionen i TV under begreppet av dataanalys! (5)

Uppg.nr.:  
(Task no.)

7

Lärares  
kommentar:  
(Teacher's  
note)

Problem med  
Publikering  
är ett annat  
problem!

Poäng:  
(Points)

# Home assignment 1

A critical reading of "Innovativeness and Entrepreneurship: Socioeconomic Remarks on Regional Development in Peripheral Regions", by Lewandowska, Stopa, and Ingot-Brzek, published in *Economics and Sociology*, 14(2), (2021).

## Summary of the article

The article aims to find and reveal potential incompatibilities between small and medium enterprises (SME) investment strategies and institutional support systems for entrepreneurship and innovation. Since the institutional support systems in general provide public funding, it is important to ensure that these money, which essentially are the taxpayer's money, are used in a most effective and successful way.

The research team has employed both statistical analysis of data collected through computer assisted telephone interviews (CATI) as well as in-depth interviews (IDI) in the study. The team used *are* Kruskal-Wallis test, which is a non-parametric test to compare medians in different groups, to measure the impact of range/scale of activities, value of investment 2011/2012, number of employers 2011/2012, engagement in R&D, cooperation index and institutional support index on the quantity of innovation. They also used a chi-square test of independence to test if the quality of innovation (possibly defined as originality of innovation) in products/services or processes were dependant *e* on these six variables. The research team also mentions testing for correlations, using Kendall's  $\tau$ .

The article concludes that for policy programs aiming to support innovation to succeed, they must take regional specificity into account.

## Scientific value of the article

Podkarpackie, the region chosen for study can be considered an outlier, given that it can be defined as a peripheral region, but despite that, rates highly on innovativeness compared to other Polish regions. This sets the region up as a potential natural experiment. The data the article is based on is collected during the years 2010 – 2016, within the frame of several different research projects. The majority of data appear to come from CATI, but there has also been some data collected through in-depth interviews. The paper doesn't provide the questionnaire in its appendix. Nor does it in any way describe the kinds of questions that were asked on the questionnaires, or even state if they were identical through the years. The paper doesn't discuss the contents of the in-depth interviews either. It does name the research projects, and potentially it'd be possible to find answers to the implied questions above if one were to look up those research projects.

In the article the following variables are presented: range/scale of activities, value of investment 2011/2012, number of employers 2011/2012, engagement in R&D, cooperation index and institutional support index. The first three of these variables are labelled as independent factors in the

section about quantity of innovation, and as hard factors in the section about the quality of innovation. The last three are considered dependant in the discussion of quantity, and soft factors when discussing quality of innovation. The range/scale of activities are only cursory explained as being active on external markets, but there's no detailing of how this is measured. Furthermore, there's no mention on how any of the "soft" factors are measured nor what parameters are contained within the two index variables.

The research team has chosen to use Kruskal-Wallis test to see if the "independent" and "dependent" variables differ in impact on the quantity of innovation. They state the reason for using this test is that the response variable (the quantity of innovation) is chi-square rather than normally distributed. They do not, however, mention that in order for Kruskal-Wallis test to hold, the groups compared need to have identically shaped and scaled distributions, with the only difference being a shift in the median. They also don't show that this assumption holds. Furthermore, I believe that the research team is confused about what normally is meant by dependant and independent variables. Unless their implied model is indeed a multivariate model where engagement in R&D, cooperation index and institutional support index are dependent on range/scale of activities, value of investment 2011/2012 and number of employers 2011/2012. I honestly can't tell from the article, and I certainly can't decipher how the group populations for the Kruskal-Wallis test are defined. From this I can't even be certain that the Kruskal-Wallis test is the correct test for their intention.

When discussing the quality of innovation, vaguely defined as originality, the research team presented a chi-square test of independence to see if either new products/services or processes were dependant on any of the six stated variables. In discussion of the results of these tests, the team also mentions they've noted a correlation between the range/scale of activities and the engagement in R&D. They also mention that they've used Kendall's  $\tau$  to measure correlation between engagement in institutional R&D and how local inspiration for innovation is and found that the less engagement with R&D, the more local the innovative inspiration was.

The team uses in-depth interviews with representatives from SME's, regional R&D institutions, and business environment institutions to put the data into context. The conclusions of the paper seems to draw most from the findings of these IDI, rather than merely using it for context, though.

It is difficult to see how the presented statistical findings support the conclusions of the study, or even if they are relevant to the subject of the study.

## **Suggestions for improvements**

I would have appreciated if the variables were better defined and also to have descriptive statistics presented with the study to ensure the reader gets a better overview of the results. Furthermore, a more in-depth description of the actual tests, specifically of the group selection criteria for the Kruskal-Wallis test would have been beneficial to understand the context and conclusions. It would

also have been nice to have the results of the correlation tests fully presented as a table, rather than as offhanded remarks in two sentences.

In addition, it appears the study doesn't have a theoretical framework to lean on, but rather appear to be exploratory. In my opinion it is a shame that the research team didn't seize on the opportunity to make use of the fact that the Podkarpackie region lends itself to a natural experiment. Comparing it to a peripheral region with a more expected level of innovativeness it may have been possible to isolate the factors that makes Podkarpackie so successful in innovation.

Good review. I would appreciate some more discussion on the scientific methodology.

20p

# Home assignment 2

A critical reading of "Financial ties of principal investigators and randomized controlled trial outcomes: cross sectional study", by Ahn, Woolbridge, Abraham, Saba, Korenstein, Madden, Boscardin and Keyhani, published in British Medical Journal, vol 356 (2017).

## Summary of the article

The research team has made a cross sectional study of randomized controlled drug trials published during 2013 and investigated if prevalence of personal financial ties among the principal investigators has a correlation with trial outcome. Such a correlation could cast doubt on the validity of drug trials both among health care professionals (ie doctors, psychologists, nurses) and the public. The article brings up that criticism has been levied that industry involvement may influence both study design and result interpretation, and also mention that according to a survey in 2002 no less than 15,5% of the responding scientists had altered design, method or result of a study after pressure from a funding source. There has been several previous studies of the association of financial ties and study outcome. The current study however differs from earlier studies in that it differentiates between personal financial ties and the funding source as well as not limiting the sample to any one speciality, drug type or journal. This would arguably give a more complete picture of the associations than previously studies that has been limited by those parameters.

The article concludes that there is a correlation between the financial ties of the primary investigators and positive study outcomes and that this might suggest bias in the evidence base.

## Scientific value of the article

The research team provides a detailed explanation of the selection process, with inclusion as well as exclusion criteria. They also detail and quantify the reasons for excluding. Since the selection process are done by four raters independently, they took a random subsample of 20 studies and calculated Cohen's  $\kappa$  for two pairs of raters to test inter-rater agreement of inclusion. They don't explain why they didn't also calculate Cohen's  $\kappa$  for the "cross pair" raters. It might be that as the inter-rater agreement score was high for both pairs, it was assumed that it would also be high between the pairs.

The research team define two variables of interest for the purpose of studying the effect of financial ties on study outcomes. The main one is the financial ties of the principal investigators, where they define principal investigator as first author and senior author. The definition of financial ties was further limited to only take into consideration if there were ties directly to the manufacturing drug company and didn't take eventual ties to the parent company of the manufacturer into account. The second one is industry funding, which is dichotomized into no funding and any funding. It is a bit confounding that they call financial ties of the principal investigators an independent variable while calling industry funding a covariate.

The research team use a battery of statistical methods. To ensure there is a statistically significant difference, they make use of the  $\chi^2$ -test. It's not immediately evident what differences they have tested for and looking at the results it may be that they have done multiple  $\chi^2$ -test for various variables, such as prevalence of financial ties depending on study design and author origin.

They do check their independent variables for multicollinearity using various methods. They first built a logistic regression model, using Fisher's scoring to approximate estimates. Along with the estimates, the correlation is calculated, and the lack of unexpectedly large estimates or standard deviation is interpreted as an indicator that there is no multicollinearity present. This is further confirmed by computation of variance inflation factors and condition indices.

The main logistic regression model is described in words as the association of study outcome and financial ties, adjusted for study funding. The research team also presents a model for a second analyses; association of study outcome and financial ties, adjusted for RCT characteristics. They additionally tested for interaction terms but found that the interaction between financial ties and industry funding was non-significant. A stratified analysis of the association of study outcome and financial ties, categorizing the studies by industry funding was also made. To analyse the sensitivity the research team also repeated the main analysis but excluded papers where the authors were unable to declare financial ties and lastly analyse the model but only including the first study in the cases where multiple studies were reported in the same article.

The research team claim that the prevalence of financial ties among the investigators where positively correlated with a positive outcome both in studies that were industry funded, as well as those that weren't. However, in the case of non-industry funded studies, the 95% CI of the odds ratio is 0,42-15 with a p-value of 0,31. The data thus doesn't support the teams conclusion that prevalence of financial ties among the investigators correlates with positive study outcome in studies that aren't funded by the industry. Given the small sample size of the studies that weren't funded by the industry, this result may not be a relevant result at all. The small sample size is mentioned as a limiting factor in the discussion, and the research team sees the necessity for further studies on this particular subset.

The data does seem to support that the prevalence of financial ties are positively correlated with study outcome and that correlation remains unchanged when analysing the expanded model.

## **Suggestions for improvements**

My first suggestion is slightly nitpicky and is more concerned with readability. Pick one terminology. Using independent variable for one and covariate for another variable had me confused for a moment.

While the method section was very verbose and detailed, I would have liked to see the models defined by using the logistic function as that would help understanding the models "at a glance".

I also found the tables somewhat confusing. The first table shows prevalence of total financial ties. Along with the frequency of studies with financial ties present and absent, there's a column of p-values. There is however no reference in the table to what test this p-value is related to. This information is instead embedded in the article, and since table references are done by using parenthesis, it can easily be missed.

I would like to hear the reasoning for excluding p-values in tables 3 to 5. It would be such a small thing to add and would make it much more readily apparent which odds ratio estimates are significant, compared to just providing the confidence intervals. After all, just providing CI's requires the reader to be aware of that the null value, where there is no association, for odds ratios is 1, not 0.

You give some (negative) comments on statistical techniques. However I would like to see a discussion on scientific methodology

18p





## 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!