ItS Gedächnisprotokoll

1. Comparing Systems [5 Points]

1.1. The goal of the Correlated Sampling method is ...

a)
b) Varianz verringern
c) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

1.2. Correlated Sampling is so named because ...

a) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
b) pairs
c) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

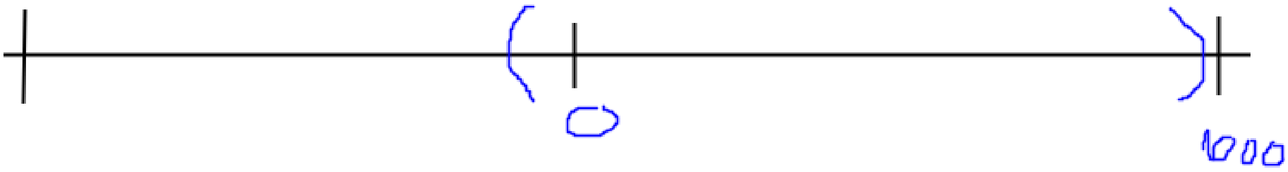
1.3. Correlated sampling works by ...

a) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
b) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
c) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

1.4. Two different systems for selling cars have been compared using simulation. The following diagram shows

a 90% confidence interval for $p1-p2$, the difference between the computed profits per year of System 1
and System 2.
Which of the following statements are true?

a) The experiment suggests that System 1 is more profitable.
b) The experiment suggests that System 2 is more profitable.



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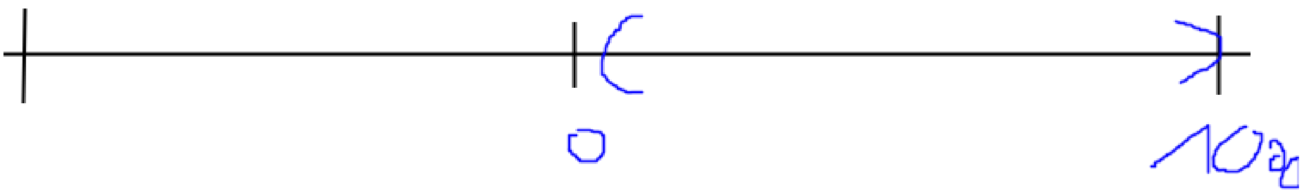


a) The result is statistically significant.
b) The result is practically significant.

2. Output Analysis [10 points]

2.1. Which of the following statements about a confidence interval are true?

a) The probability that a sample of the random variable lies inside the interval is 1 - α
b) The probability that a sample of the random variable lies inside the interval is α
c) Its width is proportional to $\sqrt{(S^2/n)}$; S^2 -> Sample Varianz & n -> anzahl der Runs

2.2. The method of independent replications...

a) unterschiedliche RNs in jeden Durchlauf gemacht und RN sind unabhängig von ein ander
practically significant -> statistically significant
b) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
c) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

2.3. Increasing the number of replications in a simulation experiment can ...

a) Varianz verringern(?)
b) macht aus einer practically significant -> statistically
c) macht aus statistisch insignificant -> statistisch significant

2.4. For a given set of random samples, compared to using $\alpha = 0.1$ as significance level, a confidence

interval using $\alpha = 0.05$

a) gives us less confidence about a more precise statement. (LEMO)
b) gives us more confidence about a less precise statement.
c) gives us more confidence about a more precise statement.

2.5. Which of the following statements are true? [2 points]

a) A statistically significant simulation result is one that XXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXX
b) For a given set of samples, a 90% confidence interval widther then a 95% confidence intervall.
c) The larger the variance in a simulation result, makes more statistically significant
d) The upper and lower bounds of a confidence interval mark the maximum and minimum values of the random variable used to generate it.

We want to compute a statistically meaningful estimate for the expected value of a random variable X. A
simulation was performed independently several times, resulting in the following six simulation results.

2.6. Calculate and mark the Sample Mean $\overline{X}$.

a) $\overline{X}$=0.5
b) $\overline{X}$=1.0 (X)
c) $\overline{X}$=2.5
d) $\overline{X}$=3.0

2.7. Calculate and mark the Sample Variance $S2$.

a) $S2$= 5.50
b) $S2$= 8.33
c) $S2$=10.00 (X)
d) $S2$=15.66

2.8. Assuming you have a set of 6 observations with a Sample Mean of 2 and a Sample Variance of 0. Which

of the following intervals is the correct confidence interval with a significance level of $\alpha = 0,05$.
(see Appendix) [2 points]
a) [−0.57,4.57] (X)
b) [2.21,4.79]
c) [−0.82,4.82]
d) [−13.42,17.42]

3. ODEs – solution [5 points]

3.1. You are using Euler's method to solve the initial value problem $y'(t)=y(t) * a - t * a + 1$; $y(0)=0$ with the timestep $h=0.5$. The value of the approximation of $y(t)$ at time $t=1$ is: [2 points]

a) 0.5
b) 1.0
c) 1.5
d) 2.0

3.2. A certain numerical integration method is of order 3. How will decreasing the step size by a factor of 2 affect the global error in the solution?

a) It will go down by a factor of about 8.
b) It will go down by a factor of about 9.
c) It will go down by a factor of about 6.

3.3. Step size control is used to ...

a) increase computer time (X)
b) avoid too large errors (X)
c) make the simulation (NONSENS?)

3.4. You are given $y'=f$ for some function f and $y(0)=y0$. You want to compute an approximation for the function $y(t)$. Which of the following statements are true?

a) f can be y und t
b) f can be only y
c) f can be t

4. ODEs – modelling [5 points]

4.1. leaky Eimer

$\frac{dl}{dt}$
is described as follows:

a)
$\frac{dl}{dt} = -c*l$ (X)

b)
$\frac{dl}{dt} = -c*l*t$

c)
$\frac{dl}{dt} = -c*t$

4.2. The Lotka-Volterra equations are a well-known example of ...

a) a system of ordinary differential equations 2 ordnung
b) a system of ordinary differential equations
c) a system of ordinary differential equations

4.3. In a system of ODEs from population biology as shown in the lecture, terms c *x^2 represent ...

a) crowding. (X)
b) being eaten by a predator.
c) death from starvation.

4.4. Which of the following statements are true? [2 points]

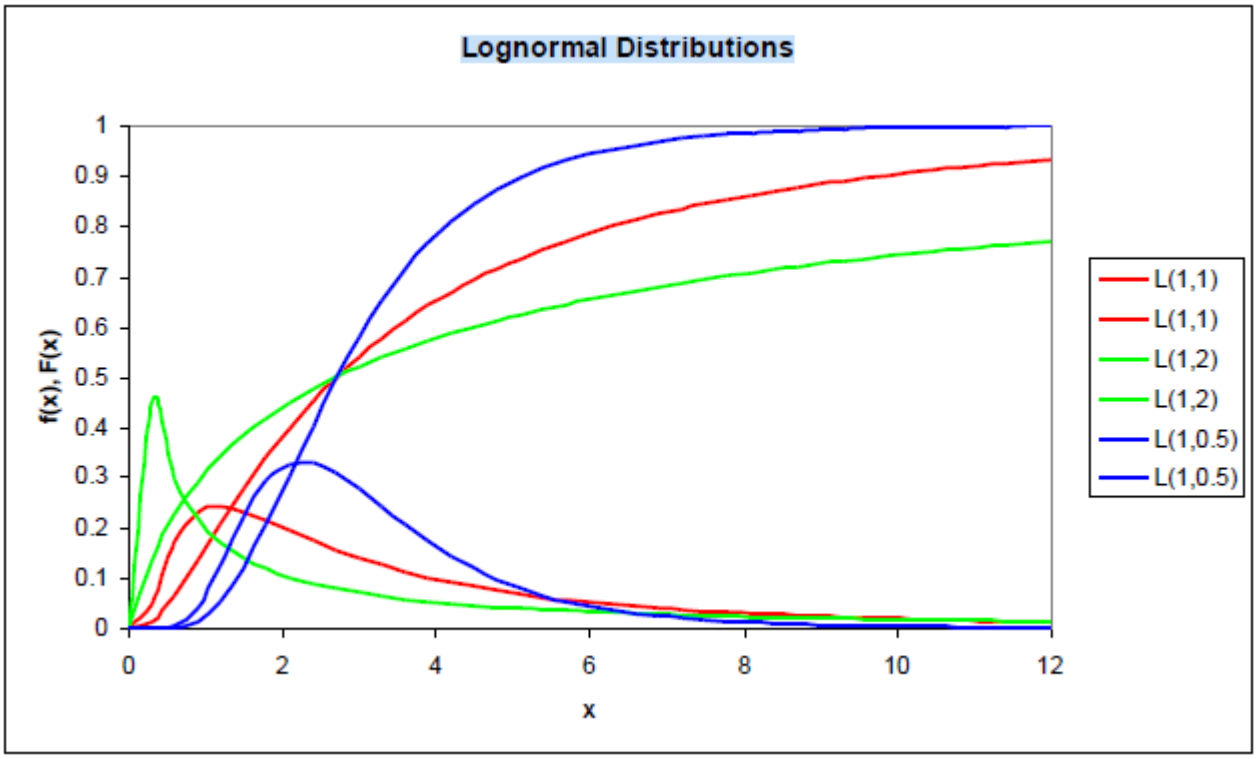
a) Explicit integration methods are always stable.
b) Extrapolation increase accuracy at low cost
c) A rocket burns fuel at the rate b (in
kg
s
). Its velocity is v (in
m
s
) and its mass (including fuel) is
m (in kg). (assume time t to be in s and c to be in
Ns
kg
)
XXXXXXXXXXXXXXXXX m-b

d) Euler's method can integrate ohne potenz aber nicht mit x^3.

5. Random variables and random numbers [10 points]

5.1. The following picture shows the probability density function of a ...

-> lognormal
so in etwa



a) Triangular distribution.
b) Uniform distribution.
c) Exponential distribution.
d) Lognormal distribution. (X)
e) Normal distribution.

5.2. Which graphs show cumulative distribution functions of a random variable? (Assume that the behaviour does not change outside of the visible area.)

lognormal
nicht negativ
(wissen nicht weiter)

a)

b)

c)

XXXXXXXXXXXXXXXXXXX

d)

XXXXXXXXXXXXXXXXXX

XXXXXXXXXXXXXXX

XXXXXXXXXX

XXXXXXX

XXXXX

XXX

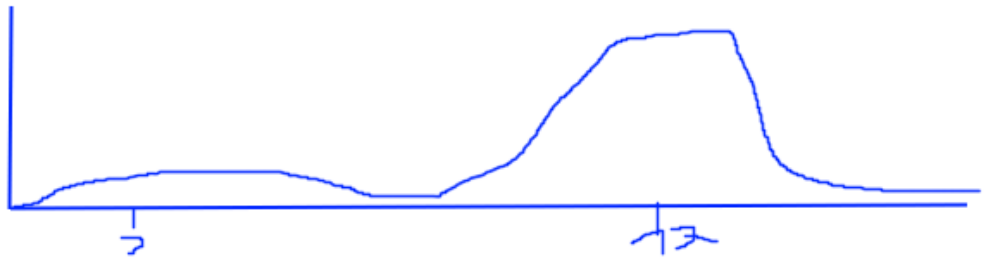
X

e)

f)

5.3. On Monday, inter-arrival times of cars at an intersection in Magdeburg were measured. The following

histogram shows XXXXXXXXXXXXXXXXXXXXXXXXXXXXX.
Which statements can be derived from the histogram?



a) There is a morning rush hour.
b) There is an evening rush hour. (X)
c) There is a noon rush hour.
d) The inter-arrival times are independent of each other.
(keine der Optionen sind richtig: X-Achse hat Werte in Sekunde; nicht als Stunden)

5.4. The linear congruential method is performed with the parameter values a=3,m=100,c=11,x_o=7.

The pseudo-random number $r2$ has the value: [2 points]
a) $r2=107$
b) $r2=32$

c) $r2$=0.07 (X)
d) $r2$=0.32
e) $r2$=7
f) $r2$=132

Mit:
x_(i+1) = (a*x_i+c)mod m
r_i = x_i / m

x_1 = (7 * 3 + 11) mod 100 = 32
r1= 32/100 = 0,32
x_2 = (32 * 3 + 11) mod 100 = 7
r2 = 7/100 = 0.07

5.5. A uniformly distributed random number generator (U[0,1]) returns 0,3 The lognormally distributed

value with μ=−1,σ=2.5 that can be computed from it is: (see Appendix)
a) $rlognorm$=0.10 (X)
b) $rlognorm$=0.23
c) $rlognorm$=0.30
d) $rlognorm$=0.48
e) $rlognorm$=0.60
f) $rlognorm$=0.92

5.6. Which graph of a probability density function best represents the random variable

"XXXXXXXXXXXXXXXXXXXXXXXXXXXXX":

a)

b)

c)

5.7. Which of the following statements are true? [3 points]

a) All inter-arrival times are XXXXXXXXXXXXX. (FALSCH)
b) The numbers generated by a pseudo random number generator XXXXXXXXXXXXXXXXXXX XXXXXXXXXXX.
c) The numbers generated by a pseudo random number generator XXXXXXXXXXXXXXXXXXX.
d) The sequence of numbers generated by a pseudo random number generator

XXXXXXXXXXXX
e) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX.
f) $F(b)-F(a)$ is the probability of an intervall inside something as long as a < b

6. DTMCs [5 points]

We assume that the solar activity level in a year only depends on the solar activity of the previous year, and can take one of
three different states: (L) Low, (N) Normal, (H) High. We assume that the progression of solar activities can be represented
by a discrete-time Markov chain (DTMC). The following table contains the number of transitions between solar activity
states of the past 100 years. (NOTE: The values are not from the real world!).

- auf Nenner: 70
- wichtige Zahlen (so um den dreh)
  - 18
  - 10
  - 16
  - 4
  - 8

6.1. Which DTMC can be derived from the above data? [2 points]

a)
eins mit nur den übergangszahlen

b)
eins mit 4/70 etc

c)
nonsense?

d) Mit Summe der Übergangswerte = 1, also 0.4, 0.4, 0.2 z.B.

6.2. Assume the following probability vector for year n:πn=(πn,L,πn,N,πn,H)=(0.5,0.3,0.2). Using the above model, the probability that in year n+1 there will be high solar activity is: [2 points]

a) πn+1,H=0.10
b) πn+1,H=0.19
c) πn+1,H=0.27
d) πn+1,H=0.33
e) πn+1,H=0.47
f) πn+1,H=0.58

6.3. Which matrices can be a transition probability matrix of a DTMC?

a)
P = (1)

b) P = (10
01)

c) jede zeile ergibt zusammen 1

d)

e)

f)

7. Input Data Analysis [10 points]

7.1. You receive a file containing 100 numbers between 0 and 1. These are assigned to five intervals

(“Observed”) according to their values. Someone claims that these numbers were created by a U(0,1)
random number generator. You want to test this claim using the Chi-Square-Test.

Do not merge any classes; round numbers to two decimal places. The Chi-Square value (χ02) is: [4 points]

a) χ02=02.00
b) χ02=05.30
c) χ02=07.60 (X)
d) χ02=09.40
e) χ02=11.00
f) χ02=13.50

7.2. You have computed the test statistic for a hypothesis using the Chi-Square test with 6 intervals and obtained X_0 $\approx$ 13. In this case the number of free distribution parameters is 0. (see Appendix for values of the χ2-distribution)

Using a significance level of $\alpha = 0.05$, the test will ...
a) ... accept the hypothesis (X)
b) ... reject the hypothesis

x0 > xf reject

7.3. The Chi-Square-Test accepts a hypothesis using a significance level of α.

The correct interpretation is:

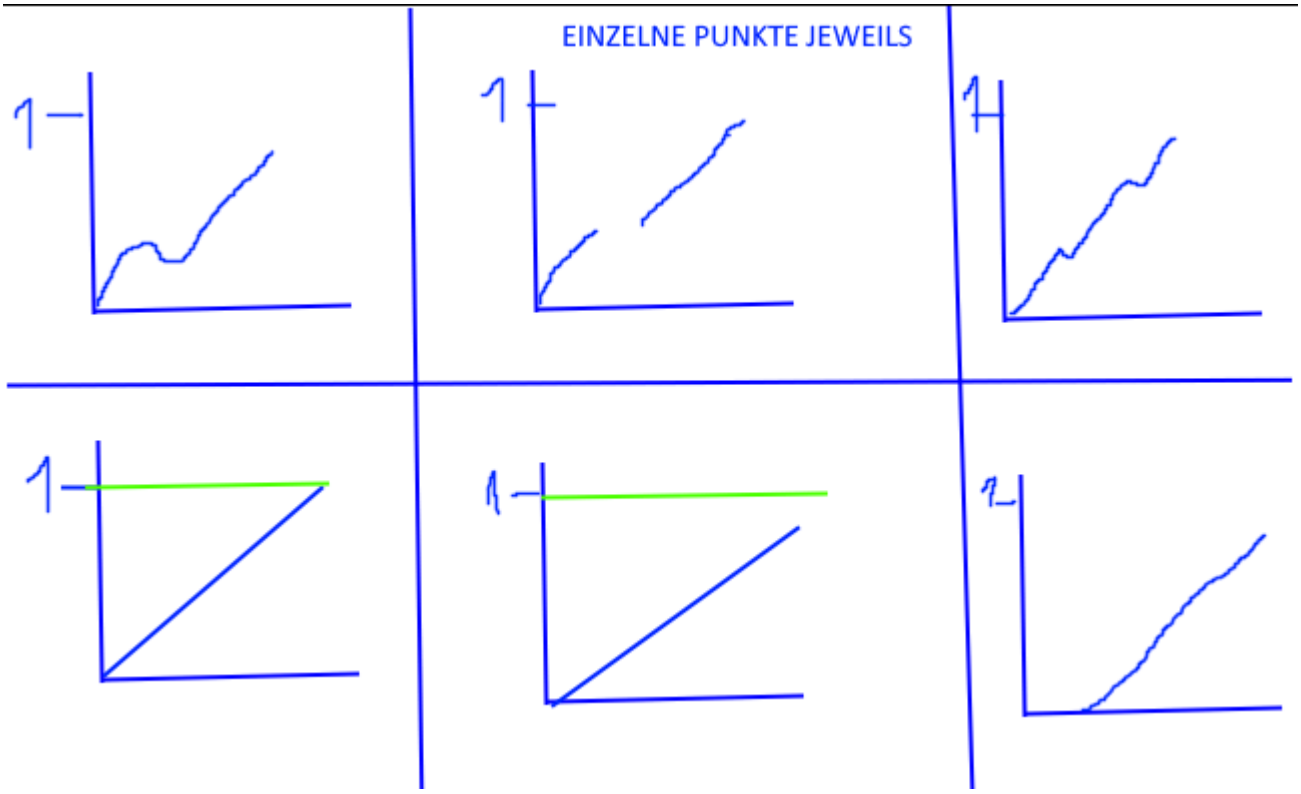
a) we are not proved, that our hypothesis is wrong (Wir können nur beweisen, dass es nicht richtig ist)
b) XXXXXXXXXXXXXXXXXXXXX
c) XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
d) XXXXXXXXXXXXXXXXXXXXXXXXXX

7.4. Which of the following statements are true? [2 points]

a) A histogram is be used to (falsch) - eigentlich um Verteilungen zu sehen
b) The GIGO = Garbage In, Garbage Out XXXXXXXXXXXXXXXXXXXXXXXXX (ist Teil der Input-Analyse oder so?)
c) The quantile-quantile plot can be used to (das unsere angenommene Hypothese über die genommene Verteilung richtig ist)
d) For the Chi-Square Test, XXXXXXXXXXXXXXXXXXXXXXXXXXXXX

7.5. We are testing a set of sample data using a q-q-plot and want to find out whether it is F-distributed and

whether we have determined the correct parameters.
Which q-q plots support the hypothesis that a given set of samples is F-distributed with correct parameters?
[2 points]



a)

mit knick

b)
unsteht

c)
leichter versatz (X)

d)

ging nicht durch ursprung

e)

war nicht exact steil (x)

f)

war gut (X)

8. Semester Assignment Sims [15 points]

IMPORTANT: Answer either Questions 8.1-8.11 or 9.1-9.11, not both! Mark the question you want to have
graded!

8.1. Which graph shows a possible progression of “XXXXXXX” over one year? [2 points]

a)

b)

c)

d)

8.2. The effect of “Taking a drink” on the relevant model variables is: [2 points]
a) Mom’s mood XXXXXXX.
b) Mom’s mood XXXXXXXX.
c) Dad’s mood XXXXXXXXX.
d) Savings are XXXXXXXXXX.
e) Son’s mood XXXXXXXXXXX.

8.3. The effect of “XXXXXXXXXX” on the relevant model variables is: [2 points]
a) Mom’s mood XXXXXXXXXXX.
b) Dad’s mood XXXXXXXXXXX.
c) Savings are XXXXXXXXXXXXXXX.
d) Son’s mood XXXXXXXXXXXXXXX.

8.4. A statistically meaningful answer to the question, “XXXXXXXXXXXXXXXXXXXXXXX” is: [2 points]
a) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
b) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
c) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
d) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
e) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
f) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Answer the following questions based on your analysis of the first year of the family life without interventions.

8.5. What is most probable at the end of year 1?

a) XXXXXXXXXXXXXXXXXXXXXXX.
b) XXXXXXXXXXXXXXXXXXXXXXX.
c) XXXXXXXXXXXXXXXXXXXXXXX.

8.6. Is the son …

a) XXXXXXXXXXXXXXXXXXXXXXX?
b) XXXXXXXXXXXXXXXXXXXXXXX?
c) XXXXXXXXXXXXXXXXXXXXXXX?

8.7. Which has a longer total duration?
a) XXXXXXXXXXXXXXXXXXXXXXX.
b) XXXXXXXXXXXXXXXXXXXXXXX.

c) XXXXXXXXXXXXXXXXXXXXXXX.

8.8. What is true of mom's mood?

a) XXXXXXXXXXXXXXXXXXXXXXX.
b) XXXXXXXXXXXXXXXXXXXXXXX.
c) XXXXXXXXXXXXXXXXXXXXXXX.

8.9. What is true of dad's mood?

a) XXXXXXXXXXXXXXXXXXXXXXX.
b) XXXXXXXXXXXXXXXXXXXXXXX.
c) XXXXXXXXXXXXXXXXXXXXXXX.

8.10. The total amount of money the family has to pay the school is …

a) XXXXXXXXXXXXXXXXXXXXXXX.
b) XXXXXXXXXXXXXXXXXXXXXXX.
c) XXXXXXXXXXXXXXXXXXXXXXX.

8.11. What is true of the family's average account balance over the year?

a) XXXXXXXXXXXXXXXXXXXXXXX.
b) XXXXXXXXXXXXXXXXXXXXXXX.
c) XXXXXXXXXXXXXXXXXXXXXXX.

9. Semester Assignment Enterprise [15 points]

IMPORTANT: Answer either Questions 8.1-8.11 or 9.1-9.11, not both! Mark the question you want to have
graded!

9.1. Which graph shows a possible behaviour of "XXXXXXXXXXX" over the whole simulation time? [2 points]

a)

b)

c)

d)

9.2. The effect of "XXXXXXXXXXXXX" on the relevant model variables is: [2 points]
a) Shield Level XXXXXXXXXX.
b) Shield Level XXXXXXXXXXXXXXX
c) Theta Level XXXXXXXXXXXXXXXX
d) Theta Level XXXXXXXXXXXXXXXXXXX

9.3. The effect of "XXXXXXXXXXXXX" on the relevant model variables is: [2 points]
a) Distance to Rift XXXXXXXXXXXXXXx
b) Distance to Rift XXXXXXXXXXXXXXXX
c) Shield Level XXXXXXXXXXXXXXXXXXXX
d) Theta Level XXXXXXXXXXXXXXXX

9.4. A statistically meaningful answer to the question,
"XXXXXXXXXXXXXXXXXXXXXXXXXXxx?"is: [2
points]
a) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXx
b) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXx
c) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
d) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
e) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
f)
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Xx

Answer the following questions based on your analysis, assuming a fixed power distribution of 30:70 (Shields:Engines).

9.5. What is the most probable scenario for the ending?
a) XXXXXXXXXXXXXXXXXXXXXXX.
b) XXXXXXXXXXXXXXXXXXXXXXX.
c) XXXXXXXXXXXXXXXXXXXXXXX.
d) XXXXXXXXXXXXXXXXXXXXXXX.

9.6. In what direction does the enterprise mainly move?
a) XXXXXXXXXXXXXXXXXXXXXXX.
b) XXXXXXXXXXXXXXXXXXXXXXX.

c) XXXXXXXXXXXXXXXXXXXXXX.

9.7 What is true of the average Theta level inside the ship?
a) XXXXXXXXXXXXXXXXXXXXXX.
b) XXXXXXXXXXXXXXXXXXXXXX.
c) XXXXXXXXXXXXXXXXXXXXXX.

9.8 What is true of the average shield level?
a) XXXXXXXXXXXXXXXXXXXXXX.
b) XXXXXXXXXXXXXXXXXXXXXX.
c) XXXXXXXXXXXXXXXXXXXXXX.

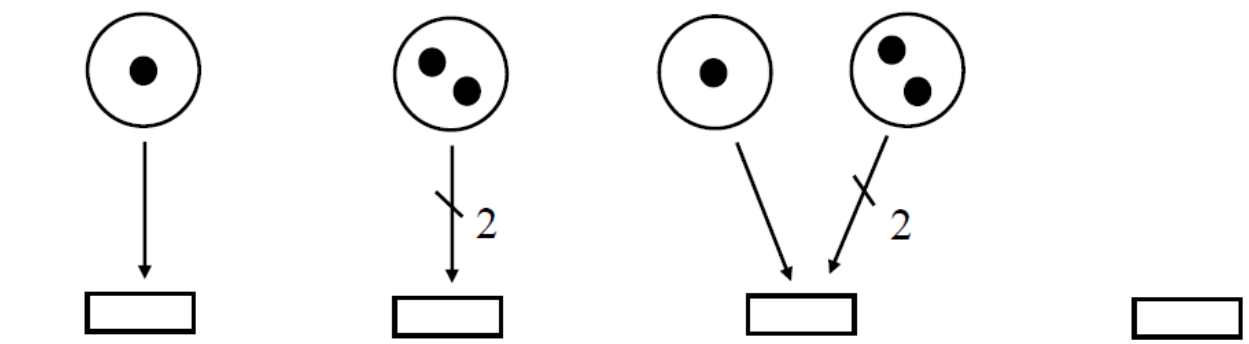
9.9 What is the average number of particle hits until the end of the simulation?
a) XXXXXXXXXXXXXXXXXXXXXX
b) XXXXXXXXXXXXXXXXXXXXXX
c) XXXXXXXXXXXXXXXXXXXXXX

9.10 What is true about the distance left to the Rift at the end of the simulation?
a) XXXXXXXXXXXXXXXXXXXXXX.
b) XXXXXXXXXXXXXXXXXXXXXX.
c) XXXXXXXXXXXXXXXXXXXXXX.

9.11 What is the average repair time the engineers manage to accumulate?
a) XXXXXXXXXXXXXXXXXXXXXX.
b) XXXXXXXXXXXXXXXXXXXXXX.
c) XXXXXXXXXXXXXXXXXXXXXX.

10. Stochastic Petri Nets [10 points]

10.1. Which transitions are currently enabled?



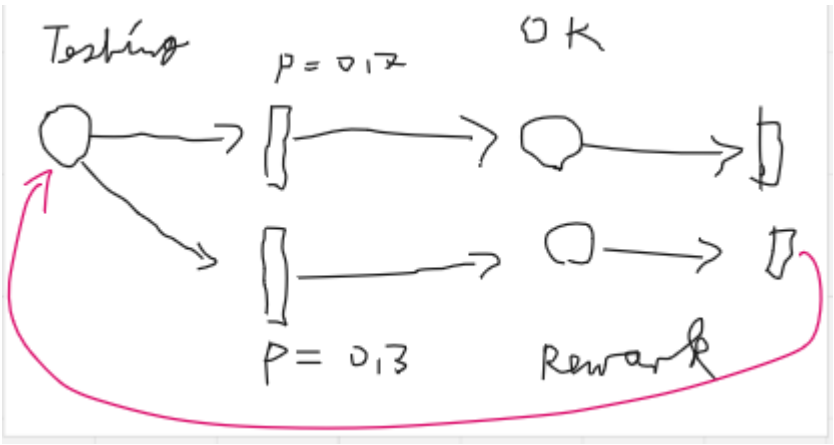
a)

b)

c)

d) (X)

10.2. Which stochastic Petri net describes the following situation in a production system: “After testing, items are either classified as OK with a probability of 0.7 or as Rework with probability 0.3?”



a)

b) (X)

c)

Use the following Petri net to answer questions 10.3 and 10.4.

SPN-firing-first

10.3. Considering the above stochastic Petri net with the marking (1,0,1,0,1,0), the following

transition(s) could fire first:
a) A
b) B (X)
c) C
d) D
e) E
f) F
g) G

10.4. Considering the above stochastic Petri net with the marking (0,1?,1?,0?,0?,1), the following

transition(s) could fire first:

a) A
b) B
c) C
d) D
e) E
f) F
g) G

10.5. Which stochastic Petri net represents the system description: “Friseur Salon mit parallelen Frisieren, Maniküre machen (?)”

a) (X)

SPN-join-split-a
b)

SPN-join-split-b
c)

SPN-join-split-c
d)

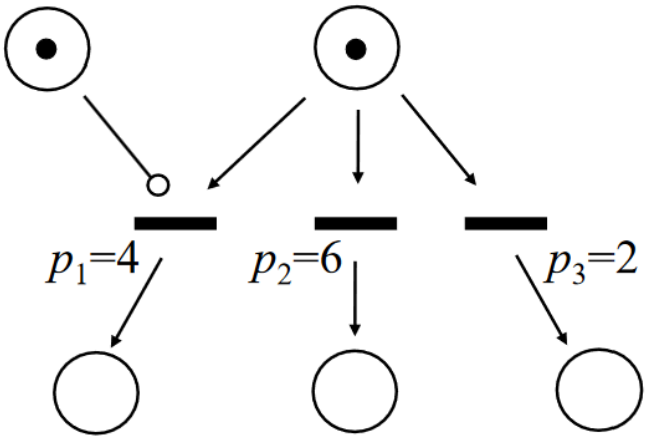
SPN-join-split-d

10.6. The probability of transition B firing is:

Firing Examples

Firing probabilities for an immediate transition:

- The probabilities are computed relative to all currently enabled transitions



$$p_1^* = 0$$

$$p_2^* = \frac{p_2}{p_2 + p_3}$$

$$p_3^* = \frac{p_3}{p_2 + p_3}$$

)
Quasi das nur mit anderen Werten

a) 0.3
b) 0.5 (X)
c) 0.7

10.7. Which pairs of stochastic Petri nets correctly display firing effects of the transition? [2 points]

Before firing

After firing

a)

b)

c) (falsch)

d)

10.8. Which of the following statements are true? [2 points]

a) A token XXXXXXXXXXXXXXXXXXX
b) A place XXXXXXXXXXXXXXXXXX
c) A timed transition XXXXXXXXXXXXXXXXXXXXX
d) An input arc determines how many tokens destroyed

11. Discrete Event-based Simulation [10 points]

The following Petri Net describes an electrolysis process: At time 10, the water reservoir (H2O) contains two
units of water and there are 4 units of hydrogen (H2) and 2 units of oxygen (O2) in their respective containers.
This system is to be simulated using a discrete event-based simulator. The SPN and Future-Event-List (FEL) of
the system are:

FEL: 11 electrical Separation
12 Prepare Ignition

The next three duration times for electrical separation are: 3,2,3

The next three duration times for prepare ignition are: XXX

Use the following table to follow the progression of the simulation until time 13.

time

11.1. The next conditional event after time 10 happens at time: [2 points]

a) 10
b) 11 (X)
c) 12
d) 13

11.2. At time 11 the following happens: [2 points]

a) Nothing
b) Electrical Separation & Refill
c) Refill (X)

11.3. The FEL at time 13 looks like: [2 points]

a) electrical Separation 14
b) electrical Separation 14 17
c) electrical Separation Refill XXXXXXXXXXX
d) Prepare Ignition - electrical Separation
electrical Separation

electrical Separation
12 Prepare Ignition

11.4. Which of the following statements are true? [4 points]

a) Replacing the earth by its center of gravity in a model of the solar system abstraction (nonse)
b) Idealization XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
c) A customer arriving at a bank conditional event (falsch)
d) A delay known length (falsch)
e) An attribute property (X)
f) The future event list (FEL) contains all scheduled primary events. (X)
g) A conditional event occur in fure by certain condition XXXX (X)
h) The system state XXXXXXXXX and complete and minimal (X)

12. Agent Based Modelling and Simulation (ABMS) [5 points]

12.1. What are necessary core elements of an agent-based simulation model?

a) Agent
b) envirement
c) Relationships
d) XXXXXXXXX
e) XXXXXXXX

12.2. What are advantages of agent based simulation?

a) cognitive and social science
b) XXXXXXXXXXXXXXXX inhomogenenus
c) XXXXXXXXXXXXXXXXXXXXXXX
d) XXXXXXXXXXXXXX

12.3. Which of the following statements are true? [3 points]

a) ABMS XXXXXXXXXXXXXXXXXXXX
b) An agent XXXXXXXXXXXXXX
c) An agent XXXXXXXXXXXXXX
d) In a continuous topology, agant move cell to cell.
e) ABMS XXXXXXXXXXXXXXXXXXXXXXXXXXXXX.
f) Agents XXXXXXXXX.

13. Verification & Validation [5 points]

13.1. Verification of a simulation program means ...

a) conceptual model vergleich (X)
b) xXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXx.
c) xYYYYYYYYYYYYYYYYYYYYYYYYx.

13.2 service time (s) wartezeit (w)

ds\dw

a) is a measure of sensitivity
b) can help to establish the face validity of a simulation result (X)
c) is a differential equation that forms part of the simulation model.

13.3. Which of the following statements are true? [3 points]

a) The Turing test face validity
b) Validation means XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
c) When you change the question you are asking about a system, XXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXX X
d) Sensitivity analysis XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
e) It is possible for a simulation model to be valid, XXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXX.
f) The following is a validation method: XXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXX X