Mid-term examination in ST0101 Statistics with Applications
Tuesday 6 March 2007 14:15–16:00

Permitted aids: Any written and printed material. One calculator.

Mark one answer for each problem on the form overleaf. You will score one point for each right answer and zero points for each wrong answer. Multiple answers will score zero.

NB: There is text on both sides of the sheet. All problems have five alternative answers.

Problem 1. We have a solution with an unknown *p*H value μ. We take 9 samples of the solution, and assume that the *p*H of these are normally distributed with expected value μ and known standard deviation 0.05. The 9 samples give an average *p*H of 7.02. We shall test $H_0\colon \mu \leq 7.00$ against $H_1\colon \mu > 7.00$. What is the p-value (significance probability) of the test?

(a) 0.02 **(b)** 0.08 **(c)** 0.12 **(d)** 0.05 **(e)** 0.10

Problem 2. We perform the test of the previous problem with 9 (new) samples and with significance level $\alpha = 0.05$. What is the probability that H_0 will be rejected if μ is in fact equal to 7.03?

(a) 1.00 **(b)** 0.56 **(c)** 0.24 **(d)** 0.05 **(e)** 0.43

Problem 3. A random sample of five newly hatched pythons weighs 32, 29, 35, 30 and 33 g. Find an estimate of the expected weight of a randomly chosen python.

(a) 32.4 g **(b)** 32.0 g **(c)** 31.6 g **(d)** 31.8 g **(e)** 32.2 g

Problem 4. Assume that the weight of a randomly chosen python is normally distributed (see the previous problem). Find a 95 % confidence interval for the expected weight (in g).

(a) $[28.4, 35.2]$ **(b)** $[28.8, 34.8]$ **(c)** $[29.4, 34.2]$ **(d)** $[29.1, 34.5]$ **(e)** $[29.7, 33.9]$

Problem 5. It is assumed that the time a seed of a grass species takes to sprout is exponentially distributed with expected time (measured in days) equal to $1/\lambda$. The time for 50 seeds are examined, and an average of 1.74 days is obtained. Find a 95 % confidence interval for λ.

(a) $[0.53, 0.84]$ **(b)** $[0.23, 0.54]$ **(c)** $[0.33, 0.64]$ **(d)** $[0.13, 0.44]$ **(e)** $[0.43, 0.74]$

Problem 6. We examine the connection between X, the number of hours per day a plant species gets broad-spectrum plant illumination, and Y, the height of the plant in cm two weeks after sowing. We make an experiment with 12 plants, where plant no. i gets plant illumination for x_i hours and get a height of y_i cm. We get an empirical correlation coefficient of $r = 0.689$ and sample standard deviations $S_X = 0.853$ and $S_Y = 1.01$. Find an estimate of the slope in a linear regression model of Y against X $(EY = \alpha + \beta X)$.

(a) 0.48 **(b)** 0.82 **(c)** 0.69 **(d)** -0.24 **(e)** 1.45

Problem 7. X and Y are independent and standard normally distributed. Find a number c such that $P(X^2 + Y^2 > c) = 0.05$.

(a) 4.99 **(b)** 5.99 **(c)** 6.49 **(d)** 6.99 **(e)** 5.49

Problem 8. Assume that X is chi-square distributed with 13 degrees of freedom. Find a number a such that $P(X < a) = 0{,}025$.

(a) 4.40 **(b)** 23.34 **(c)** 21.03 **(d)** 24.74 **(e)** 5.01

Problem 9. Let the proportion of females in a randomly chosen mosquito swarm of a certain species be X. It is known that X has a probability density given by $f(x) = \theta x^{\theta-1}$, where $0 < x < 1$ and θ is a positive parameter. The proportion of females in five randomly chosen swarms are 0.45, 0.68, 0.87, 0.36 and 0.54. Find the maximum likelihood estimate of θ.

(a) 5.80 **(b)** 1.69 **(c)** 0.58 **(d)** 0.97 **(e)** 0.53

Problem 10. What is the probability that a t-distributed random variable with 10 degrees of freedom is less than 2.764?

(a) 0.5 **(b)** 0.05 **(c)** 0.95 **(d)** 0.01 **(e)** 0.99

Problem	a	b	c	d	e
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2					
3					
4					
5					
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8					
9					
10					

Studentnummer Student number

Studieprogram Study program

Inspektør Inspector