Comments to most frequent errors in tests

4.11 - Model

- question 1: the form of a model is $f(y_t|\psi_t, \Theta)$ - we model the output at time t in dependence on the variables from the regression vector ψ_t. The bounds between y_t and variables from ψ_t are expressed by the parameters Θ
- question 7: model between discrete output y_t and regression vector ψ_t with also continuous variables is the logistic one. It cannot be regression model, because $\psi_t\theta$ does not give discrete variables and it also cannot by discrete model because it would have dimension equal to infinity.

6.11 - Estimation

- question 6: it is a formula - must be remembered.
- question 8: posterior pdf can be used practically in all cases, but it leads ti difficult computations. That is why point estimates are used, frequently.
- question 9: point estimates op parameters of discrete model are given by normalization of the statistics - e.g. in tossing a coin: you count Heads and Tailes. The probabilities are P(Head)=Heads/(Heads+Tails) and similarly for P(Tail).
- model of logistic regression uses regression vector x and has binary output. This output can be used for classification of the regression vectors into two groups of regression vectors - one denoted by $y = 0$ and the other by $y = 1$.

11.11 - Prediction

- question 2: y_t cannot be predicted from old inputs (only from past outputs).
- question 6: it is necessary to include also zero-step prediction
- question 7: the same as question 6
- question 8: prediction is expectation $E[y_t|y(t-1)] = \int y_t f(y_t|y(t-1))\, dy_t$ which is just a number. According to point prediction (point estimate of the output) the prediction is the most probable value.
- question 9: prediction is a number (does not need to be within $(0, 1)$)
- question 10: generally prediction does not need to be a realization of the random variable.

13.11 - Filtration

- question 4: KF has two parts: prediction and filtration.
- question 5: KF works with expectation and variance of the state distribution. These characteristics fully determine normal distribution. Fro it we get assumption of normality (which is reproduced during the procedure).
- question 6: state part of state-space model deals with state;
  noise cannot be predicted.
- question 7: data update increases the time in data $d(t-1) \rightarrow d(t)$.
- question 8: at state prediction the time at data remains the same, the time at state is increased.
- question 10: state noise is associated with state, output noise with output

18.11 - Control

- question 1: when we speak about control then the control variable is generated by a control algorithm
- question 2: measurements are performed in e period of sampling; control is designed for a control interval
- question 6: application of the control law (which is designed from the end of control interval and runs against the time) can start only when we come to the beginning; only here we know data $d(0)$ which are necessary for substitution into the control law. Here we compute u_1, apply it and get the response y_1. Now we know $d(1) = \{y_1, u_1, d(0)\}$ and can construct u_2, etc.
- question 9: penalization of y is used to obtain optimal control, tat is true. Bud penalization of u is used to get not so big values of control
- question 10: dynamic programming generates optimal control. Sub-optimal control is produced in the adaptive one - parallel estimation of parameters and optimization of the control law.

20.11 - Notions 1

- questions 1,2,3: we defined: process is a piece of reality, system is a set of variables with their relations and model is a mathematical expression of the relations.
- question 5: the input variable (control) is set by us - so it must be manipulated

- question 8: one of the main properties of the state is that it cannot be measured and only can be estimated.

25.11 - Notions 2

- question 1: the model order is given by the number of delayed outputs, no matter how many delayed inputs is are included
- question 2,3: the variables are always discrete in time (discrete measurements). Continuous variables have real values, discrete variables have discrete values (finite or countably many).
- question 5: in estimation we estimate
- question 7: in control we control (generate control variable)
- question 8: Kalman filter estimates state variable
- question 9: the basic assumption for Kalman filter is normality
- question 10: state estimation estimates state.

27.11 - Notions 3

- question 2: information matrix is a statistics used in estimation of parameters of regression model. Its update is $V_t = V_{t-1} + \Psi_t \Psi_t^{'}$
- question 3: point estimate of parameters is expectation of parameters computed a follows: $\hat{\Theta}_t = \int_{-\infty}^{\infty} \Theta f\left(\Theta | d\left(t\right)\right) d\Theta$
- question 4: prior knowledge can be given either by an expert or can be extracted from prior data (those, collected before the estimation itself starts)
- question 7: order of regression model is given by the number of delayed outputs included into regression vector
- question 8: a model which has regression vector with at least one delayed output is called dynamic
- question 10: filtration (state estimation) is composed of two parts - prediction and filtration. The latter part is based on the Bayes rule

2.12 - Notions 4

- question 2: Bayes rule gives density of one variable, only.
- question 3: prior information can be extracted either from prior data or expert knowledge.
- question 4: Bayesian statistics considers parameters to be random variables - posterior density is their description.
- question 6: state variable depends only on its last values and present control

$$x_t = Mx_{t-1} + Nu_t + w_t$$

- question 7: entries of white noise must be mutually independent - they are unpredictable.
- question 10: parameters of a discrete model are entries of the model table. They are probabilities and thus they must lie within the interval $(0, 1)$.