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Criteria used for assessing the level of readiness of the human-operator

Fundamental specifications of preparation for human-operator are manageable. An individual approach for the trainee may be applied. A process of the preparation of human-operator can be both, optimized as well as be organized in a flexible manner, thus not excluding the presence of each statement.

Evaluation criteria of practical skills while preparation

The most important part of the preparation of an air traffic controller is a practical preparation on a simulator. Simulator training process nowadays is strictly predefined in its objectives and goals. Typical simulator training is aimed to the successful Skill Equation (SA) by trainee and is based on the average expected result of the SA success. Correspondingly, all the typical practical preparation of the future air traffic controller does not take into consideration individual aspects of particular trainee. Thus, expecting quality of the resulted SA level of the group of trainee is naturally dividing into three groups or domains.

1st group (barely pass criteria) is characterized by a potentially unsuccessful result of SA level with a huge variety of different practical gaps and un-correspondence of air traffic control skills.

2nd group (surely pass criteria) is a domain of trainees who successfully completed required tasks and gained expected level of practical skills.

3rd group (easily pass criteria) is a group of trainee who always will be requiring more from the practical preparation and naturally tending to getting bored and lowering of their level of attention and awareness, thus tending to short-cut of required procedures and breeding the 'bad habit '

Preparation process is successful when the objective is met. As a rule, the objective is to enable the trainee to perform as required in his or her day-to-day work.

The time as absolute criterion for preparation

If training time not such a critical resource, an instructor could simply wait and observe whether or not the trainee can properly apply on the work place. That would be the perfect measure of success. In the reality we are objectively limited in time for getting a trainee sufficiently prepared for the future operations as an air traffic controller. An instructor for simulator training is also taking hired for the limited, and again, objectively required amount of time. Procedure, which to be trained by a trainee, contains a time for execution as the main criteria of the successful completion.

For the evaluation of practical SA of a trainee, consolidated criterion is used, it is named – Technological Operation Criterion (TOC) (table 1).

Table 1. Technological operation criteria

№	*TOC*	*Evaluation mark*		
		excellent	good	satisfied
1	Acceptance of duty on the work place	0 errors	1 error	2 errors
2	Phraseology adequacy	≤1 error	2-3 errors	4 errors
3	Coordination with adjacent units	≤1 error	2-3 errors	4 errors
4	Regularity of flights	0 errors	1 error	2 errors
5	Accuracy of aircraft's positions determination	0 errors	1 error	2 errors
	By distance	±5 kilometres		
	By Azimuth	±4 degrees		
	By direction finder	±2 degrees		
6	Correspondence of decision making to given situation	0 errors	1 error	2 errors
7	Provision of proper separation and general Safety issues	0 errors	1 error	2 errors and more
8	Adequacy of console operations	≤1 error	2-3 errors	4 errors and more

Mentioning error/s (*E*) throughout the table should be understood in the manner of: error itself (slips and lapses), mistakes (knowledge-based errors), mismatches, inadequacy etc. Distribution of *E* among Technological Operations (Pr_i) through one given task is represented in (Fig. 2).

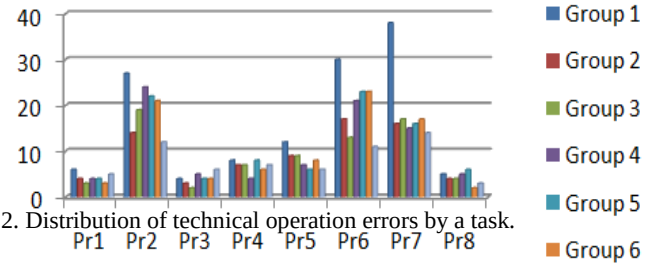


Fig. 2. Distribution of technical operation errors by a task.

It is recognisable in a glance, that phraseology adequacy (*Pr2*), correspondence of decision making to given situation (*Pr6*) and provision of proper separation and general Safety issues (*Pr7*) are the most dramatic in theirs proportion to other operations (Fig. 3).

Model and estimation of regression parameters

Consider a linear model of observations

$$Y_i = \beta_1 + x_{i2}\beta_2 + U_i \ , \ i = 1,..., n \ .(1)$$

Where U_i independent equally distributed random variables,

β_1 and β_2 unknown regression parameters,

x_{i2} non-random values of the regressor. According to observations

Y_i, x_{i2}, $i = \overline{1,n,}$

To be evaluated β_1 and β_2 and to test the hypothesis

$H_0 : \beta_2 = 0$

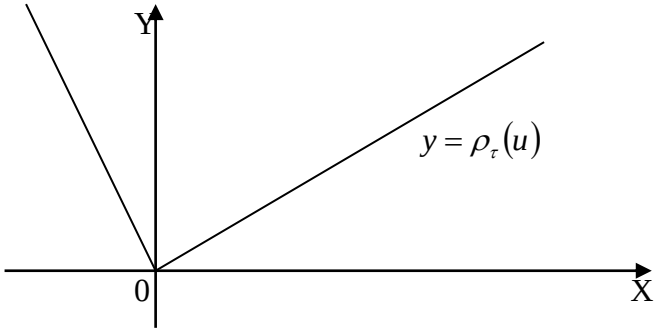
against a bilateral alternative

$H_1 : \beta_2 \neq 0$.

We will build a Least Absolute Deviations (LAD).

For $\tau \in (0,1)$ consider a quantile regression function

$$\rho_\tau(u) = \begin{cases} u\tau, & u \geq 0 \\ u(\tau - 1), & u \leq 0. \end{cases}$$



Let's mark $\beta = (\beta_1, \beta_2)^T$ - vector regression parameter. Model (1) can be written more compactly:

$$Y_i = x_i^{\mathrm{T}}\beta + U_i, \ i = \overline{1,n,}$$

where $x_i = (1, x_{i2})^T$, that is $x_{i1} \equiv 1$.

Quantile evaluation $\hat{\beta}(\tau)$ is given by equality

$$\hat{\beta}(\tau) = \arg\min_{b \in R^2} \sum_{i=1}^{n} \rho_\tau \left(Y_i - x_i^{\mathrm{T}} \beta \right)$$

We will be mainly interested in the case of $\tau = \frac{1}{2}$. Then

$\rho_{\frac{1}{2}}(u) = \frac{1}{2}|u|$,

$\hat{\beta}\left(\frac{1}{2}\right)$ - this is an estimate of Least Absolute Deviations $\hat{\beta}_{LAD}$:

$$\hat{\beta} = \hat{\beta}_{LAD} = \arg\min_{\beta \in R^2} \sum_{i=1}^{n} \left| Y_i - x_i^{\mathrm{T}} \beta \right|.$$

Estimate $\hat{\beta}$ is built by numerical methods, using linear programming. This estimate is robust compared to the usual least squares estimate.

References

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