



## LITHUANIAN SPORTS UNIVERSITY

### STUDY MODULE PROGRAMME (SMP)

Module Code	S	274	M	030	Accredited until				Renewal date		
	Branch of Science		Progr.	Registr. №.							

**Entitlement**

Methodology and Statistics in Biomedical Research

**Prerequisites**

University education, bachelor degree; Passed elementary course in research methodology and biomedical science

**Course (module) Learning Outcomes**

№.	Learning Outcomes	Teaching / Learning Methods	Assessment Methods
1	Will acquire modern knowledge and clear understanding of complex biological systems, testing technologies for these systems as well.	Interactive lecture, Scientific paper analysis	Control work
2	Will be able to apply creative research techniques and data analysis methods in practice.	Debates	Control work
3	Will be able to raise relevant statistical hypotheses, to select adequate statistical hypotheses and methods of data analysis, to plan and execute a scientific experiment, to use modern testing devices and methods for testing muscles, cardiovascular, central nervous and oxygen transport systems	Case analysis (Case study), Group work, Practical exercises (tasks)	Control work
4	Will be able to study scientific literature, to discuss, interpret, compare the results of the research with other authors, to summarize, and to prepare a scientific publication	Case analysis (Case study), Scientific paper analysis	Individual work
5	Will be able to interpret the results of many factors in the environment and formulate scientific conclusions.	Seminar	Directed private laboratory work

**Main aim**

In accordance with modern statistics and achievements in methodology science provide knowledge and abilities for students: a) to use modern testing devices and methods for testing the muscles, cardiac, central nervous system and oxygen transport systems; b) to plan the research for statistically validated hypothesis testing; c) follow the ethics norms in biomedical research; d) collect data, analyse them by using modern packages for computer-statistical analyses, interpret results and make scientific conclusions; d) prepare the highest level of scientific publication.

**Summary**

Modern technologies in the research of the central nervous system, skeletal muscle, human motor control and learning and their application in fundamental and applied biology. Statistical hypotheses and their verification using modern software packages for statistical analysis. Parametric and nonparametric tests. Correlation, regression analysis, One-Way and Two-Way analysis of variance (GLM–general linear model–univariate and multivariate analysis), factor and cluster analysis. Article and master thesis preparation.

**Level of module**

Level of programme		Subject group (under the regulation of the area)	Subject level
Cycle	Type		
Second	Master	Specialaus lavinimo	Applied

**Group under financial classification**

## Syllabus

№.	Sections and themes	Responsible lecturer
1.	Science metrics	
2.	Modern central nervous system research technologies (TMS, fMRI, PET, EEG), their application in fundamental and applied biology research	
3.	Modern skeletal muscle research technologies, their application possibilities in fundamental and applied biology research	
4.	Modern research technologies of movement control and learning, possibilities of their application in fundamental and applied biology research	
5.	Modern technologies of metabolic activity research, their application in fundamental and applied biology research	
6.	Modern technologies of human thermoregulation research, their application in fundamental and applied biology research	
7.	Modern rehabilitation research technologies, their application possibilities in fundamental and applied biology research	
8.	Portable bio-sensors for health monitoring - the technologies of the future	
9.	Errors in applied research	
10.	The ethics of biological research	
11.	Statistical hypotheses and their verification. Parametric and nonparametric tests, p-value, observed power, effect size (Partial Eta Squared)	
12.	Introduction to Statistical Package for the Social Sciences (SPSS). Data entering. Definition of the variable properties	
13.	Descriptive statistics. Central tendency and dispersion. Creating and editing SPSS charts	
14.	The relationship of the exploratory data. Correlation coefficients. Partial correlation. Parametric and nonparametric tests for statistical hypothesis testing	
15.	Reliability analysis of the questionnaires. Criterion of consistency or agreement	
16.	Factor analysis. Tests for factor homogeneity	
17.	General Linear Model (GLM). Univariate and multivariate analysis of variance by one or more factor variables	
18.	Repeated measures ANOVA and mixed-model designs including both within-subject and between-subject factors	
19.	SPSS regression analysis. Linear regression. Binary logistic regression. Ordinal regression	
20.	Discriminant analysis. ROC curves. Cluster analysis	

Evaluation procedure of knowledge and abilities:

### References

№.	Title	Edition in Lithuanian Sports University library		In Lithuanian Sports University bookstore	Number of ex. in the methodical cabinet of the depart.
		Pressmark	Number of exemplars		
1.	Skurvydas, A. Apie mokslą, tiesą ir pažangą // Kaunas, LKKA, 2010.			Yes	
2.	Skurvydas, A. Paradigm errors in the old biomedical science // Medicina (Kaunas). 2008, 44(5):356-365. IF:0.4.			No	
3.	Daniuseviciute, L. Pukenas, K. Brazaitis, M. Skurvydas, A. Sipaviciene, S. Ramanauskiene, I. Linonis, V. Wavelet-Based Entropy Analysis of Electromyography during 100 Jumps // Elektronika ir Elektrote			No	

№.	Title	Edition in Lithuanian Sports University library		In Lithuanian Sports University bookstore	Number of ex. in the methodical cabinet of the depart.
		Pressmark	Number of exemplars		
4.	Racinais, S. Gaoua, N. Grantham, J. Hyperthermia impairs short-term memory and peripheral motor drive transmission // <i>Journal of Physiology</i> . 2008, 586(19):4754. IF:5.14			No	
5.	Kamandulis, S. Kanavolaitė, A. Skurvydas, A. Skikas, L. Streckis, V. Mickevičienė, D. Pukėnas, K. Jurevičienė, V. Masiulis, N. Reliability and validity of DPA-1 testing after anterior cruciate ligamen			No	
6.	Skurvydas, A. Brazaitis, M. Kamandulis, S. Sipaviciene, S. Muscle Damaging Exercise Affects Isometric Force Fluctuation as well as Intraindividual Variability of Cognitive Function// <i>Journal of Motor</i>			No	
7.	Skurvydas A, Brazaitis M, Andrejeva J, Mickeviciene D, Streckis V. The effect of multiple sclerosis and gender on central and peripheral fatigue during 2-min MVC // <i>Clinical Neurophysiology</i> . 2011, 122			No	
8.	Brazaitis, M. Skurvydas, A. Heat acclimation does not reduce the impact of hyperthermia on central fatigue // <i>European Journal of Applied Physiology</i> . 2010, 109:772–774. IF:2.2			No	
9.	Brazaitis M, Kamandulis S, Skurvydas A, Daniusevičiūtė L. The effect of two kinds of T-shirts on physiological and psychological thermal responses during exercise and recovery // <i>applied ergonomics</i> . 2			No	
10.	Skurvydas A, Brazaitis M, Kamandulis S. Prolonged muscle damage depends on force variability // <i>International Journal of Sports Medicine</i> . 2010, 31(2):77-81. IF:2.38			No	
11.	McMorris T, Swain J, Smith M, Corbett J, Delves S, Sale C, Harris RC, Potter J. Heat stress, plasma concentrations of adrenaline, noradrenaline, 5-hydroxytryptamine and cortisol, mood state and cognit			No	
12.	Venckūnas T, Stasiulis A, Raugaliene R. Relationship between echocardiographic and aerobic capacity parameters in distance runners // <i>International journal of cardiology</i> . 2005, 102(3):531-2. IF:6.8			No	
13.	Bojsen-Møller J, Losnegard T, Kemppainen J, Viljanen T, Kalliokoski KK, Hallén J. Muscle use during double poling evaluated by positron emission tomography // <i>Journal of applied physiology</i> . 2010, 109:			No	
14.	Hopkins SR, Levin DL, Emami K, Kadlecek S, Yu J, Ishii M, Rizi RR. Advances in magnetic resonance imaging of lung physiology // <i>Journal of applied physiology</i> . 2007, 102(3):1244-54. IF:4.23			No	
15.	McKinley, R.A. Bridges, N. Walters, C.M. Nelson, J. Modulating the brain at work using noninvasive transcranial stimulation // <i>Neuroimage</i> . 2012, 59(1):129-37. IF:5.9			No	
16.	Nielsen, B. Nybo, L. Cerebral changes during exercise in the heat // <i>Sports medicine</i> . 2003, 33(1):1-11. IF:5.07			No	
17.	Hogan, N. Krebs, H.I. Physically interactive robotic technology for neuromotor rehabilitation // <i>Prog Brain Res</i> . 2011, 192:59-68. IF:3.1			No	

№.	Title	Edition in Lithuanian Sports University library		In Lithuanian Sports University bookstore	Number of ex. in the methodical cabinet of the depart.
		Pressmark	Number of exemplars		
18.	Brochard, S. Robertson, J. Médée, B. Rémy-Néris, O. What's new in new technologies for upper extremity rehabilitation? // <i>Curr Opin Neurol.</i> 2010, 23(6):683-7. IF:5.02			No	
19.	Klitzman, R. Appelbaum, P.S. Research ethics. To protect human subjects, review what was done, not proposed // <i>Science.</i> 2012, 335(6076):1576-7. IF: 31.3			No	
20.	Sokal, R.R. Rohlf, F.J. <i>Biometry</i> // 4th edition, New York, W. H. Freeman, 2011.			No	
21.	Čekanavičius, V. Murauskas, G. <i>Statistika ir jos taikymai</i> // (2) Vilnius, TEV, 2002			No	
22.	Čekanavičius, V. Murauskas, G. <i>Statistika ir jos taikymai</i> // (3) Vilnius, TEV, 2009.			No	
23.	Garson G. D. <i>Statnotes: Topics in Multivariate Analysis.</i> 2012. <a href="http://faculty.chass.ncsu.edu/garson/PA765/statnote.htm">http://faculty.chass.ncsu.edu/garson/PA765/statnote.htm</a>			No	
24.	Skurvydas A. <i>Judesių mokslas: raumenys, valdymas, mokymas, reabilitavimas, sveikatinimas, treniravimas, metodologija</i> // Kaunas, LKKA, 2010.			Yes	
25.	Lane J. Let's make science metrics more scientific. <i>Nature.</i> 2010 Mar 25; 464 (7288): 488-9			No	
26.	Biagioli M. Watch out for cheats in citation game. <i>Nature.</i> 2016 Jul 14;535(7611):201			No	
27.	Bernecke V, Pukenas K, Daniuseviciute L, Baranauskiene N, Paulauskas H, Eimantas N, Brazaitis M. Sex-specific reliability and multidimensional stability of responses to tests assessing neuromuscular function. <i>Homo.</i> 2017 Dec;68(6):452-464			No	
28.	Bernecke V, Pukenas K, Imbrasiene D, Mickeviciene D, Baranauskiene N, Eimantas N, Brazaitis M. Test-Retest Cross-Reliability of Tests to Assess Neuromuscular Function as a Multidimensional Concept. <i>J Strength Cond Res.</i> 2015 Jul;29(7):1972-84			No	
29.	Skurvydas A, Jurgelaitiene G, Kamandulis S, Mickeviciene D, Brazaitis M, Valanciene D, Karanauskiene D, Mickevicius M, Mamkus G. What are the best isometric exercises of muscle potentiation? <i>Eur J Appl Physiol.</i> 2019 Apr;119(4):1029-1039			No	
30.	Skurvydas A, Verbickas V, Eimantas N, Baranauskiene N, Cernych M, Skrodeniene E, Daniuseviciute L, Brazaitis M. Psychological and Physiological Biomarkers of Neuromuscular Fatigue after Two Bouts of Sprint Interval Exercise. <i>Front Psychol.</i> 2017 Dec 22;8:2282			No	
31.	Brazaitis M, Paulauskas H, Eimantas N, Obelieniene D, Baranauskiene N, Skurvydas A. Heat transfer and loss by whole-body hyperthermia during severe lower-body heating are impaired in healthy older men. <i>Exp Gerontol.</i> 2017 Oct 1;96:12-18			No	

Additional literature

№.	Title
1.	Costafreda SG, Brammer MJ, David AS, Fu CH. (2008) Predictors of amygdala activation during the processing of emotional stimuli: a meta-analysis of 385 PET and fMRI studies. <i>Brain Res Rev.</i> 58(1):57-70.
2.	Skurvydas, A. Masiulis, N. Gudas, R. Dargevičiūtė, G. Parulytė, D. Trumpickas, V. Kalesinskas, J.R. (2011). Extension and flexion torque variability in ACL deficiency. <i>Knee Surg Sports Traumatol Arthrosc.</i> 19 (8) : 1307 – 13.
3.	Skurvydas, A. Kamandulis, S. Stanislovaitis, A. Streckis, V. Mamkus, G. Drazdauskas, A. (2008). Leg immersion in warm water, stretch-shortening exercise, and exercise-induced muscle damage. <i>J Athl Train.</i> 43(6):592-9.
4.	Kamandulis S, Skurvydas A, Snieckus A, Masiulis N, Aagaard P, Dargeviciute G, Brazaitis M. (2011). Monitoring markers of muscle damage during a 3 week periodized drop-jump exercise programme. <i>J Sports Sci.</i> 29(4):345-53.
5.	van der Lans, A.A. Hoeks, J. Brans, B. Vijgen, G.H. Visser, M.G. Vosselman, M.J. Hansen, J. Jörgensen, J.A. Wu, J. Mottaghy, F.M. Schrauwen, P. van Marken Lichtenbelt, W.D. (2013). Cold acclimation recruits human brown fat and increases nonshivering thermogenesis. <i>J Clin Invest.</i> 123(8):3395-403.
6.	Palmieri, R.M. Ingersoll, C.D. Hoffman, MA. (2004). The hoffmann reflex: methodologic considerations and applications for use in sports medicine and athletic training research. <i>J Athl Train.</i> 39(3):268-77.
7.	Gatti, R. Tettamanti, A. Gough, P.M. Riboldi, E. Marinoni, L. Buccino, G. (2013). Action observation versus motor imagery in learning a complex motor task: a short review of literature and a kinematics study. <i>Neurosci Lett.</i> 540:37-42.
8.	Ren, J. Li, H. Palaniyappan, L. Liu, H. Wang, J. Li, C. Rossini, P.M. (2014). Repetitive transcranial magnetic stimulation versus electroconvulsive therapy for major depression: A systematic review and meta-analysis. <i>Prog Neuropsychopharmacol Biol Psychiatry.</i>
9.	Geroïn, C. Mazzoleni, S. Smania, N. et al. (2013). Systematic review of outcome measures of walking training using electromechanical and robotic devices in patients with stroke. <i>J Rehabil Med.</i> 45(10):987-96.
10.	Gatti, R. Tettamanti, A. Gough, P.M. Riboldi, E. Marinoni, L. Buccino, G. (2013). Action observation versus motor imagery in learning a complex motor task: a short review of literature and a kinematics study. <i>Neurosci Lett.</i> 540:37-42.
11.	Nybo L. (2008). Hyperthermia and fatigue. <i>J Appl Physiol</i> (1985). 104(3):871-8.
12.	Mäestu, J. Jürimäe, J. Jürimäe, T. (2005). Monitoring of performance and training in rowing. <i>Sports Med.</i> 35(7):597-617.
13.	Čekanavičius, V. Murauskas, G. (2002). <i>Statistika ir jos taikymai I.</i> Vilnius, TEV
14.	Čekanavičius, V. Murauskas, G. (2009). <i>Statistika ir jos taikymai II.</i> Vilnius, TEV

Coordinating lecturer

Position	Degree, surname, name	Schedule №.
Professor		478

Subdivision

Entitlement	Code
a	2006

Study module teaching form №. 1

Semester	Mode of studies	Structure				Total hours	Credits	
		Theory	Seminars	Lab Works	Ind. work			
A	S	D	13	17	0	230	260	10

Languages of instruction:

Lithuanian	L	English	E	Russian	R	French	F	German	G	Other	Oth.
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Plan of in-class hours

№. of Themes	Academic hours			№. of Themes	Academic hours		
	Theory	Seminars	Lab Works		Theory	Seminars	Lab Works
1.	3	0	0	11.	1	0	0
2.	1	0	0	12.	0	1	0
3.	1	0	0	13.	0	1	0
4.	1	0	0	14.	0	2	0
5.	1	0	0	15.	0	1	0
6.	1	0	0	16.	0	3	0
7.	1	0	0	17.	0	3	0
8.	1	0	0	18.	0	3	0
9.	1	0	0	19.	0	2	0
10.	1	0	0	20.	0	1	0
				Total:	13	17	0

Schedule of individual work tasks and their influence on final grade

	№. of syllabus	Total hours	Influence on grade, %	Week of presentment of task (*) and reporting (o)																
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17-20
Control work	16	44	20				*	0												
Reporting for laboratory work	1-10	54	20					*										0		
Exam	11-20	44	20						*										0	
Control work	17	44	20							*	0									
Control work	18	44	20										*				0			
Total:		-	230	100																

Study module teaching form №. 2

Semester		Mode of studies	Structure				Total hours	Credits
			Theory	Seminars	Lab Works	Ind. work		
A	S	N	13	17	0	230	260	10

Languages of instruction:

Lithuanian	L	English	E	Russian	R	French	F	German	G	Other	Oth.
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Plan of in-class hours

№. of Themes	Academic hours			№. of Themes	Academic hours		
	Theory	Seminars	Lab Works		Theory	Seminars	Lab Works
1.	3	0	0	11.	1	0	0
2.	1	0	0	12.	0	1	0
3.	1	0	0	13.	0	1	0
4.	1	0	0	14.	0	2	0
5.	1	0	0	15.	0	1	0
6.	1	0	0	16.	0	3	0
7.	1	0	0	17.	0	3	0
8.	1	0	0	18.	0	3	0
9.	1	0	0	19.	0	2	0
10.	1	0	0	20.	0	1	0
				Total:	13	17	0

