Respondents

A total of 17 institutions responded to the Business Calculus survey. One response consisted of the statement, “We no longer teach a Business Calculus course,” and two stated the number of Business Calculus courses they teach, but answered no other question. There were, therefore, only 14 actual responses. Of the 17, 13 were public, and four were private. Of the public institutions, UBC Vancouver, UBC Okanagan, SFU, and Douglas offered two courses, Kwantlen and Capilano had two listed but hadn’t offered the second in a while, five offered only one course, and one had no Business Calculus course. All the private colleges and universities offered two courses. We think it may be worthwhile to find out how many institutions offer the two courses regularly. In any case, given the low number of institutions offering both courses, we have not analyzed responses on topics appearing only in Calculus II.

Responses

A topic was viewed broadly as core if 11 out of 14 respondents viewed it as core, and it was borderline if 10 viewed it as core. Otherwise is was not viewed as core. Where a topic had fewer than 14 responses, it was assumed that the nonresponses were “not core.”

Limits

All topics were in Calculus I. The only topic that was not viewed broadly as core is 54. Using asymptotes to answer questions about real life situations.

Possible Learning Outcomes

We expect students to understand the definition of limit, understand what it represents in real-life, and be able to use the properties of limits to evaluate them. We expect that they can evaluate limits algebraically, graphically, and numerically. We expect that they can find one-sided limits, find horizontal asymptotes and vertical asymptotes, recognize unbounded behavior of functions, find infinite limits and limits to infinity. We expect that they can determine continuity of functions, both at points and on closed intervals.

Derivatives

All topics were in Calculus I. The only topics that were not viewed broadly as core were 31, Writing derivatives in simplified form; 66. Finding derivatives of logs and exponentials involving other bases; 133. Finding derivatives of sine and cosine (borderline, though core for B.Sc. institutions), 134, 135, and 136, Finding derivatives of the other trig functions; Finding maximums and minimums of sine and cosine; and Using them in real life applications.

Possible Learning Outcome

We expect students to be able to identify the tangent line at a point and find its slope. We expect that they are able to use the limit definition to find the derivative, find derivatives using the rules of differentiation, including the product, quotient and chain rules, and be able to use the general power rule. We expect that they be able to find derivatives of algebraic functions, and functions involving the natural log and exponential functions, as well as sine and cosine. We expect that they be able to find derivatives implicitly, and be able to find higher-order derivatives.

Sketching

All topics were viewed broadly as core, with the exception of 54. Using asymptotes in real life situations.

Possible Learning Outcomes

We expect that students be able to find vertical and horizontal asymptotes, determine when a function is increasing or decreasing, identify critical numbers, determine concavity, and to use calculus to analyze the graphs of functions, including those involving exponentials

Optimization

All topics were viewed broadly as core, with the exception of 135. Extrema for sine and cosine.

Possible Learning Outcomes

We expect students be able to find the relative extrema of functions using calculus, use the First Derivative and Second Derivative Tests to classify such extrema, and find global extrema on closed intervals. We expect that they be able to solve real-life optimization problems, including ones in business and economics.

Derivative Applications

Only 26. Finding marginal; 36. Using derivatives in real life situations; and 37. Related rates were viewed broadly as core. Topics 51. Recognizing basic business terms; 57. Using marginal to estimate revenue etc. were borderline, though viewed broadly as core by the B.Sc. institutions.

Possible Learning Outcomes

We can suggest none because the survey results are contradictory. How can a Business Calculus course not cover elasticity and the use of marginals for estimating revenue, etc?

Topics with No Suggested Learning Outcomes

Exponentials

Very low response rate. Only 63. Using calculus to analyze graphs involving logs or exponentials was viewed broadly as core. B.Sc. institutions viewed broadly as core 13. Compound interest, 63, 67, Exponential growth and decay.

Trig

Low response rate. No topic was viewed broadly as core. 133. Finding derivatives of sine and cosine was borderline, though viewed broadly as core by the B.Sc. institutions; and 135. Relative extrema of sine and cosine was also viewed broadly as core by the B.Sc. institutions.

Multivariate Calculus

Low response rate.

Integration

Only 4 said some integration was covered in Calculus I. Eight cover it in Calculus II, and one does it in both.

Functions

Low response rate.

Limits

Course	Question		All	B.Sc.
Calc I	4	Finding limits of functions graphically and numerically	14, 0, 0	7, 0, 0
	5	Understanding the definition of the limit of a function and using the properties of limits to evaluate limits of functions	13, 0, 0	7, 0, 0
	6	Using different analytic techniques to evaluate limits of functions	13, 1, 0	6, 1, 0
	7	Evaluating one-sided limits	14, 0, 0	7, 0, 0
	8	Interpreting in everyday language the meaning of a limiting value in an applied context	12, 2, 0	5, 2, 0
	9	Recognizing unbounded behavior of functions	14, 0, 0	7, 0, 0
	10	Determining the continuity of functions	14, 0, 0	7, 0, 0
	11	Determining the continuity of functions on a closed interval	12, 2, 0	5, 2, 0
	52	Finding the vertical asymptotes of functions and find infinite limits	13, 1, 0	6, 1, 0
	53	Finding the horizontal asymptotes of functions and find limits at infinity	14, 0, 0	7, 0, 0
	54	Using asymptotes to answer questions about real-life situations	10, 4, 0	4, 3, 0
Neither	5	Understanding the definition of the limit of a function and using the properties of limits to evaluate limits of functions	0, 1, 0	

Differentiation

Course	Question		All	B.Sc.
Calc I	15	Identifying the tangent line to a graph at a point	14, 0, 0	7, 0, 0
	16	Approximating the slopes of tangent lines to graphs at points	11, 2, 0	5, 1, 0
	17	Using the limit definition to find the slopes of graphs at points	13, 1, 0	7, 0, 0
	18	Using the limit definition to find the derivatives of functions	13, 1, 0	6, 1, 0
	19	Describing the relationship between differentiability and continuity	12, 2, 0	6, 1, 0
	20	Finding the derivatives of functions using the Constant Rule	13, 0, 0	7, 0, 0
	21	Finding the derivatives of functions using the Power Rule	14, 0, 0	7, 0, 0
	22	Finding the derivatives of functions using the Constant Multiple Rule	13, 0, 0	6, 0, 0
	23	Finding the derivatives of functions using the Sum and Difference Rules	14, 0, 0	7, 0, 0
	24	Finding the average rates of change of a function over an interval	12, 1, 0	6, 0, 0
	25	Finding the instantaneous rate of change of a function at a point	14, 0, 0	7, 0, 0

	27	Finding the derivatives of functions using the Product Rule	14, 0, 0	7, 0, 0
	28	Finding the derivatives of functions using the Quotient Rule	14, 0, 0	7, 0, 0
	29	Finding derivatives using the Chain Rule	14, 0, 0	7, 0, 0
	30	Finding derivatives using the General Power Rule	12, 1, 0	6, 0, 0
	31	Writing derivatives in simplified form	8, 2, 1	3, 1, 0
	32	Finding higher-order derivatives	13, 0, 0	7, 0, 0
	33	Finding and using a position function to determine the velocity and acceleration of a moving object	8, 3, 0	2, 3, 0
	34	Finding derivatives explicitly	14, 0, 0	7, 0, 0
	35	Finding derivatives implicitly	12, 2, 0	6, 1, 0
	62	Finding the derivatives of natural exponential functions	14, 0, 0	7, 0, 0
	65	Finding the derivatives of natural logarithmic functions	14, 0, 0	7, 0, 0
	66	Finding the derivatives of exponential and logarithmic functions involving other bases	9, 5, 0	4, 3, 0
	133	Finding derivatives of sine and cosine	10, 0, 0	5, 0, 0
	134	Finding derivatives of tangent, cotangent, secant, and cosecant	8, 2, 0	3, 2, 0
	135	Finding the relative extrema of trigonometric functions	9, 1, 0	5, 0, 0
	136	Using derivatives of trigonometric functions to answer questions about real-life situations.	6, 3, 0	1, 3, 0
Neither	16	Approximating the slopes of tangent lines to graphs at points	0, 1, 0	0, 1, 0
	24	Finding the average rates of change of a function over an interval	1, 0, 0	1, 0, 0
	30	Finding derivatives using the General Power Rule	0, 1, 0	0, 1, 0
	31	Writing derivatives in simplified form	0, 1, 2	0, 1, 2
	33	Finding and using a position function to determine the velocity and acceleration of a moving object	0, 2, 1	0, 1, 1
	133	Finding derivatives of sine and cosine	0, 3, 0	0, 2, 0
	134	Finding derivatives of tangent, cotangent, secant, and cosecant	0, 3, 0	0, 2, 0
	135	Finding the relative extrema of trigonometric functions	0, 3, 0	0, 2, 0
	136	Using derivatives of trigonometric functions to answer questions about real-life situations.	0, 4, 0	0, 3, 0

Sketching

Course	Question		All	B.Sc.
Calc I	39	Testing for increasing and decreasing functions	14, 0, 0	7, 0, 0
	44	Determining the intervals on which the graphs of functions are concave upward or concave downward	14, 0, 0	7, 0, 0
	45	Finding the points of inflection of the graphs of functions	14, 0, 0	7, 0, 0

	52	Finding the vertical asymptotes of functions and find infinite limits	13, 1, 0	6, 1, 0
	53	Finding the horizontal asymptotes of functions and find limits at infinity	14, 0, 0	7, 0, 0
	54	Using asymptotes to answer questions about real-life situations	10, 4, 0	4, 3, 0
	55	Analyzing the graphs of functions	14, 0, 0	7, 0, 0
	63	Using calculus to analyze the graphs of functions that involve the natural exponential function	13, 1, 0	7, 0, 0

Optimization

Course	Question		All	B.Sc.
Calc I	40	Finding the critical numbers of functions and finding the open intervals on which functions are increasing or decreasing	14, 0, 0	7, 0, 0
	41	Recognizing the occurrence of relative extrema of functions	14, 0, 0	7, 0, 0
	42	Using the First-Derivative Test to find the relative extrema of functions	14, 0, 0	7, 0, 0
	43	Finding absolute extrema of continuous functions on a closed interval	14, 0, 0	7, 0, 0
	46	Using the Second-Derivative Test to find the relative extrema of functions	12, 2, 0	6, 1, 0
	48	Solving real-life optimization problems	13, 1, 0	6, 1, 0
	49	Solving business and economics optimization problems	11, 2, 0	6, 1, 0
	135	Finding the relative extrema of trigonometric functions	9, 1, 0	5, 0, 0
Neither	49	Solving business and economics optimization problems	0, 1, 0	
	135	Finding the relative extrema of trigonometric functions	0, 3, 0	0, 2, 0

Derivative Applications

Course	Question		All	B.Sc.
Calc I	26	Finding the marginal revenues, marginal costs, and marginal profits for products	12, 1, 0	6, 1, 0
	33	Finding and using a position function to determine the velocity and acceleration of a moving object	8, 3, 0	2, 3, 0
	36	Using derivatives to answer questions about real-life situations	13, 1, 0	6, 1, 0
	37	Solving related-rate problems	11, 2, 0	5, 1, 0
	47	Finding the points of diminishing returns of input-output models	5, 2, 0	2, 0, 0
	50	Finding the price elasticity of demand for demand functions	8, 2, 0	4, 2, 0
	51	Recognizing basic business terms and formulasÂ such as revenue, profit, or break-even point	10, 1, 0	5, 0, 0
	56	Finding the differentials of functions	8, 6, 0	3, 4, 0
	57	Using marginals in economics to approximate changes in revenue, cost, and profit	10, 3, 0	5, 2, 0

	58	Finding the differential of a function using differentiation formulas	8, 6, 0	3, 4, 0
	64	Exploring the normal probability density function	0, 1, 0	
	123	Using relative extrema to answer questions about real-life situations	1, 1, 0	1, 1, 0
	170	Using Newtonâ€™s Method to approximate the zeros of functions	3, 4, 0	1, 2, 0
	171	Understanding the situations in which Newtonâ€™s Method may not converge	3, 2, 0	1, 1, 0
Calc II	64	Exploring the normal probability density function	2, 0, 0	1, 0, 0
	123	Using relative extrema to answer questions about real-life situations	5, 1, 0	1, 1, 0
	124	Understanding the Method of Lagrange Multipliers	6, 0, 0	2, 0, 0
	125	Using Lagrange multipliers to solve constrained optimization problems	6, 0, 0	2, 0, 0
	126	Finding the sum of the squared errors for mathematical models	1, 1, 0	
	127	Finding the least squares regression lines for data	1, 1, 0	
Neither	26	Finding the marginal revenues, marginal costs, and marginal profits for products	0, 1, 0	
	33	Finding and using a position function to determine the velocity and acceleration of a moving object	0, 2, 1	0, 1, 1
	37	Solving related-rate problems	0, 1, 0	0, 1, 0
	47	Finding the points of diminishing returns of input-output models	0, 5, 0	0, 3, 0
	50	Finding the price elasticity of demand for demand functions	0, 4, 0	0, 1, 0
	51	Recognizing basic business terms and formulasÂ such as revenue, profit, or break-even point	0, 1, 1	0, 0, 1
	57	Using marginals in economics to approximate changes in revenue, cost, and profit	0, 1, 0	
	64	Exploring the normal probability density function	0, 8, 2	0, 5, 0
	123	Using relative extrema to answer questions about real-life situations	0, 1, 1	0, 1, 0
	124	Understanding the Method of Lagrange Multipliers	0, 2, 1	0, 2, 0
	125	Using Lagrange multipliers to solve constrained optimization problems	0, 2, 1	0, 2, 0
	126	Finding the sum of the squared errors for mathematical models	0, 2, 3	0, 2, 1
	127	Finding the least squares regression lines for data	0, 2, 3	0, 2, 1
	170	Using Newtonâ€™s Method to approximate the zeros of functions	0, 3, 1	0, 2, 0
	171	Understanding the situations in which Newtonâ€™s Method may not converge	0, 5, 1	0, 3, 0

Exponentials

Course	Question	Question	All	B.Sc.
Calc I	13	Using compound interest models to solve real-life problems	7, 1, 0	5, 0, 0
	60	Solving compound interest problems	5, 1, 0	2, 1, 0
	61	Solving present value problems	3, 2, 0	1, 0, 0
	63	Using calculus to analyze the graphs of functions that involve the natural exponential function	13, 1, 0	7, 0, 0
	67	Using exponential growth and decay to model real-life situations	9, 2, 1	5, 1, 0
Calc II	13	Using compound interest models to solve real-life problems	0, 1, 0	0, 1, 0
	60	Solving compound interest problems	0, 1, 0	0, 1, 0
	61	Solving present value problems	1, 1, 0	1, 1, 0
	67	Using exponential growth and decay to model real-life situations	1, 1, 0	0, 1, 0
Calc I and II	60	Solving compound interest problems	1, 0, 0	1, 0, 0
Neither	13	Using compound interest models to solve real-life problems	0, 3, 2	0, 1, 0
	60	Solving compound interest problems	0, 2, 2	0, 1, 0
	61	Solving present value problems	0, 5, 1	0, 3, 0

Trig

Course	Question		All	B.Sc.
Calc I	133	Finding derivatives of sine and cosine	10, 0, 0	5, 0, 0
	134	Finding derivatives of tangent, cotangent, secant, and cosecant	8, 2, 0	3, 2, 0
	135	Finding the relative extrema of trigonometric functions	9, 1, 0	5, 0, 0
	136	Using derivatives of trigonometric functions to answer questions about real-life situations.	6, 3, 0	1, 3, 0
	137	Learning the trigonometric integration rules that correspond directly to differentiation rules	1, 0, 0	
	138	Integrating the six basic trigonometric functions	1, 0, 0	
	139	Using trigonometric integrals to solve real-life problems	1, 0, 0	
Calc II	137	Learning the trigonometric integration rules that correspond directly to differentiation rules	6, 0, 0	3, 0, 0
	138	Integrating the six basic trigonometric functions	4, 2, 0	1, 2, 0
	139	Using trigonometric integrals to solve real-life problems	2, 4, 0	0, 2, 0
Calc I and II	137	Learning the trigonometric integration rules that correspond directly to differentiation rules	1, 0, 0	
	138	Integrating the six basic trigonometric functions	1, 0, 0	
Neither	133	Finding derivatives of sine and cosine	0, 3, 0	0, 2, 0
	134	Finding derivatives of tangent, cotangent, secant, and cosecant	0, 3, 0	0, 2, 0
	135	Finding the relative extrema of trigonometric functions	0, 3, 0	0, 2, 0
	136	Using derivatives of trigonometric functions to answer questions about real-life situations.	0, 4, 0	0, 3, 0

	137	Learning the trigonometric integration rules that correspond directly to differentiation rules	0, 3, 0	0, 2, 0
	138	Integrating the six basic trigonometric functions	0, 3, 0	0, 2, 0
	139	Using trigonometric integrals to solve real-life problems	0, 3, 1	0, 2, 1

Multivariate Calculus

Course	Question		All	B.Sc.
Calc I	105	Plotting points in space	1, 0, 0	1, 0, 0
	112	Evaluating functions of several variables	2, 0, 0	2, 0, 0
	113	Finding the domains and ranges of functions of two variables	1, 0, 0	1, 0, 0
	114	Reading contour maps and sketching level curves of functions of two variables	1, 0, 0	1, 0, 0
	115	Using functions of several variables to answer questions about real-life situations	1, 1, 0	1, 1, 0
	116	Finding the first partial derivatives of functions of two variables	3, 0, 0	3, 0, 0
	117	Finding the slopes of surfaces in the x- and y-directions and using partial derivatives to answer questions about real-life situations	2, 1, 0	2, 1, 0
	118	Finding the partial derivatives of functions of several variables	3, 0, 0	3, 0, 0
	119	Finding higher-order partial derivatives	3, 0, 0	3, 0, 0
	120	Understanding the relative extrema of functions of two variables	2, 0, 0	2, 0, 0
	121	Using the First-Partials Test to find the relative extrema of functions of two variables	2, 0, 0	2, 0, 0
	122	Using the Second-Partials Test to find the relative extrema of functions of two variables	2, 0, 0	2, 0, 0
	123	Using relative extrema to answer questions about real-life situations	1, 1, 0	1, 1, 0
Calc II	105	Plotting points in space	5, 1, 0	2, 0, 0
	106	Finding distances between points in space and find midpoints of line segments in space	3, 2, 0	1, 1, 0
	107	Writing the standard forms of the equations of spheres and finding the centers and radii of spheres	1, 3, 0	0, 2, 0
	108	Sketching the coordinate plane traces of surfaces	2, 1, 0	
	109	Sketching planes in space	3, 2, 0	1, 1, 0
	110	Drawing planes in space with different numbers of intercepts	1, 2, 0	0, 1, 0
	111	Classifying quadric surfaces in space	1, 0, 0	
	112	Evaluating functions of several variables	6, 0, 0	2, 0, 0
	113	Finding the domains and ranges of functions of two variables	4, 2, 0	1, 1, 0
	114	Reading contour maps and sketching level curves of functions of two variables	3, 2, 0	1, 0, 0
	115	Using functions of several variables to answer questions about real-life situations	5, 1, 0	1, 1, 0
	116	Finding the first partial derivatives of functions of two variables	6, 0, 0	2, 0, 0

	117	Finding the slopes of surfaces in the x- and y-directions and using partial derivatives to answer questions about real-life situations	5, 1, 0	1, 1, 0
	118	Finding the partial derivatives of functions of several variables	4, 2, 0	1, 1, 0
	119	Finding higher-order partial derivatives	5, 1, 0	2, 0, 0
	120	Understanding the relative extrema of functions of two variables	6, 0, 0	2, 0, 0
	121	Using the First-Partials Test to find the relative extrema of functions of two variables	5, 0, 0	2, 0, 0
	122	Using the Second-Partials Test to find the relative extrema of functions of two variables	6, 0, 0	2, 0, 0
	123	Using relative extrema to answer questions about real-life situations	5, 1, 0	1, 1, 0
	124	Understanding the Method of Lagrange Multipliers	6, 0, 0	2, 0, 0
	125	Using Lagrange multipliers to solve constrained optimization problems	6, 0, 0	2, 0, 0
	126	Finding the sum of the squared errors for mathematical models	1, 1, 0	
	127	Finding the least squares regression lines for data	1, 1, 0	
Calc I and II	105	Plotting points in space	0, 1, 0	0, 1, 0
Neither	105	Plotting points in space	0, 1, 1	0, 1, 0
	106	Finding distances between points in space and find midpoints of line segments in space	0, 2, 2	0, 2, 1
	107	Writing the standard forms of the equations of spheres and finding the centers and radii of spheres	0, 2, 2	0, 2, 1
	108	Sketching the coordinate plane traces of surfaces	0, 4, 1	0, 4, 0
	109	Sketching planes in space	0, 3, 1	0, 3, 0
	110	Drawing planes in space with different numbers of intercepts	0, 3, 1	0, 3, 0
	111	Classifying quadric surfaces in space	0, 2, 4	0, 2, 2
	112	Evaluating functions of several variables	0, 1, 1	0, 1, 0
	113	Finding the domains and ranges of functions of two variables	0, 2, 1	0, 2, 0
	114	Reading contour maps and sketching level curves of functions of two variables	0, 2, 2	0, 2, 1
	115	Using functions of several variables to answer questions about real-life situations	1, 1, 1	1, 1, 0
	116	Finding the first partial derivatives of functions of two variables	0, 1, 1	0, 1, 0
	117	Finding the slopes of surfaces in the x- and y-directions and using partial derivatives to answer questions about real-life situations	0, 1, 1	0, 1, 0
	118	Finding the partial derivatives of functions of several variables	0, 1, 1	0, 1, 0
	119	Finding higher-order partial derivatives	0, 1, 1	0, 1, 0
	120	Understanding the relative extrema of functions of two variables	0, 1, 1	0, 1, 0
	121	Using the First-Partials Test to find the relative extrema of functions of two variables	0, 1, 1	0, 1, 0

	122	Using the Second-Partials Test to find the relative extrema of functions of two variables	0, 1, 1	0, 1, 0
	123	Using relative extrema to answer questions about real-life situations	0, 1, 1	0, 1, 0
	124	Understanding the Method of Lagrange Multipliers	0, 2, 1	0, 2, 0
	125	Using Lagrange multipliers to solve constrained optimization problems	0, 2, 1	0, 2, 0
	126	Finding the sum of the squared errors for mathematical models	0, 2, 3	0, 2, 1
	127	Finding the least squares regression lines for data	0, 2, 3	0, 2, 1

Functions

Course	Question		All	B.Sc.
Calc I	12	Using the greatest integer function to model and solve real-life problems	4, 5, 0	1, 2, 0
Neither	12	Using the greatest integer function to model and solve real-life problems	0, 3, 1	0, 3, 0