Задание 1)

Полученная выборка:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| -3.41938 | 1.16375 | -0.48423 | 3.18687 | 1.65830 | -0.91055 | 3.17200 | 0.57451 | 4.33148 | -1.55506 |
| -1.10570 | 0.01584 | 3.62201 | 0.43492 | -0.27804 | 2.60946 | -1.38345 | -1.86311 | -2.83698 | 2.54883 |
| -2.96379 | 1.60007 | 0.76336 | 1.56464 | 1.51394 | -0.99685 | 0.65567 | -0.42172 | 0.10594 | 0.70173 |
| 1.44911 | 2.98624 | -3.81508 | -3.47485 | -3.23239 | 1.52948 | -2.71202 | 3.72059 | 0.32328 | -2.54836 |
| 0.80319 | -0.37975 | 1.97732 | -0.45867 | -1.26359 | -1.56686 | -1.35846 | 1.29475 | -2.81496 | 1.69229 |
| 0.03771 | 0.04595 | 4.46792 | 1.18613 | -1.19233 | -0.75523 | 1.28561 | 0.91927 | 2.45968 | -0.59971 |
| -0.23860 | -1.99965 | -0.15561 | -0.38043 | 0.69596 | -2.04313 | -1.03511 | -2.11438 | -4.26711 | 2.96899 |
| 1.19954 | 2.51308 | 1.85695 | -2.36627 | 1.54859 | -0.20508 | -1.88209 | 1.26181 | -1.98450 | -2.01668 |
| -1.05951 | 1.61224 | -1.98562 | 3.82919 | 4.05208 | 1.41556 | 3.64918 | -2.44670 | 0.36317 | -2.04978 |
| -3.26729 | 0.00486 | 2.30364 | 0.51686 | 0.98750 | 1.21405 | 0.53487 | -0.20960 | 2.62371 | 1.24873 |
| -3.79429 | -1.65437 | 4.76518 | -1.78814 | -0.35574 | 0.10661 | -0.75592 | 2.39940 | 2.43348 | -0.96688 |
| 0.50165 | 7.46306 | 0.22037 | -0.07852 | -0.60370 | 1.16222 | -0.78884 | 1.23366 | -0.71186 | 0.68438 |
| -0.07069 | 3.29687 | -0.38676 | -0.70831 | 2.08303 | 1.58235 | 5.95893 | -1.18743 | -1.35612 | -0.00978 |
| 1.42044 | 0.28755 | 0.04978 | 0.94703 | -1.29245 | -2.15035 | -0.44091 | -0.10394 | 2.67289 | -0.33502 |
| 1.24936 | 0.40473 | 0.88622 | 4.37701 | 0.68814 | -3.65955 | -1.47423 | 0.49579 | 2.98502 | 1.49159 |
| -1.52323 | -1.70732 | -2.79224 | -3.00831 | -1.10247 | -2.13875 | -4.86603 | -0.78863 | 2.47714 | 1.10348 |
| 1.97699 | -0.90311 | -2.99731 | -0.95257 | -1.15897 | -3.36916 | 3.83449 | 0.58166 | -0.28003 | -3.59553 |
| -0.59612 | -3.00332 | -2.05623 | -1.93565 | -0.32867 | 0.44716 | 2.62060 | -0.19244 | 2.48821 | -0.90512 |
| 0.15995 | -1.43265 | -1.62721 | -0.36575 | 0.11759 | -2.57789 | 1.82642 | 0.65731 | 1.71577 | 4.18185 |
| 1.12922 | -1.79057 | -1.50080 | 2.78135 | -4.32864 | -5.69638 | 2.54350 | 4.12742 | 0.95021 | 0.58230 |
| -0.60391 | 1.43782 | 2.29356 | 2.96383 | 2.02109 | -4.98954 | -1.78194 | 1.88825 | 3.36258 | -1.40659 |
| 1.89974 | -2.92459 | 1.00484 | 0.60604 | 0.56484 | 0.72057 | -0.30440 | 6.03645 | 0.25745 | 0.21788 |
| 1.78879 | 0.39895 | 1.56788 | -1.19022 | 0.38916 | 1.25926 | -1.84040 | 2.44751 | 2.76881 | 2.79080 |
| -3.46407 | 1.14493 | -2.11212 | 2.53613 | 1.06432 | 3.06702 | 2.10938 | -1.16123 | 1.68686 | 1.71780 |

Упорядоченная выборка:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| -5.69638 | -4.98954 | -4.86603 | -4.32864 | -4.26711 | -3.81508 | -3.79429 | -3.65955 | -3.59553 | -3.47485 |
| -3.46407 | -3.41938 | -3.36916 | -3.26729 | -3.23239 | -3.00831 | -3.00332 | -2.99731 | -2.96379 | -2.92459 |
| -2.83698 | -2.81496 | -2.79224 | -2.71202 | -2.57789 | -2.54836 | -2.44670 | -2.36627 | -2.15035 | -2.13875 |
| -2.11438 | -2.11212 | -2.05623 | -2.04978 | -2.04313 | -2.01668 | -1.99965 | -1.98562 | -1.98450 | -1.93565 |
| -1.88209 | -1.86311 | -1.84040 | -1.79057 | -1.78814 | -1.78194 | -1.70732 | -1.65437 | -1.62721 | -1.56686 |
| -1.55506 | -1.52323 | -1.50080 | -1.47423 | -1.43265 | -1.40659 | -1.38345 | -1.35846 | -1.35612 | -1.29245 |
| -1.26359 | -1.19233 | -1.19022 | -1.18743 | -1.16123 | -1.15897 | -1.10570 | -1.10247 | -1.05951 | -1.03511 |
| -0.99685 | -0.96688 | -0.95257 | -0.91055 | -0.90512 | -0.90311 | -0.78884 | -0.78863 | -0.75592 | -0.75523 |
| -0.71186 | -0.70831 | -0.60391 | -0.60370 | -0.59971 | -0.59612 | -0.48423 | -0.45867 | -0.44091 | -0.42172 |
| -0.38676 | -0.38043 | -0.37975 | -0.36575 | -0.35574 | -0.33502 | -0.32867 | -0.30440 | -0.28003 | -0.27804 |
| -0.23860 | -0.20960 | -0.20508 | -0.19244 | -0.15561 | -0.10394 | -0.07852 | -0.07069 | -0.00978 | 0.00486 |
| 0.01584 | 0.03771 | 0.04595 | 0.04978 | 0.10594 | 0.10661 | 0.11759 | 0.15995 | 0.21788 | 0.22037 |
| 0.25745 | 0.28755 | 0.32328 | 0.36317 | 0.38916 | 0.39895 | 0.40473 | 0.43492 | 0.44716 | 0.49579 |
| 0.50165 | 0.51686 | 0.53487 | 0.56484 | 0.57451 | 0.58166 | 0.58230 | 0.60604 | 0.65567 | 0.65731 |
| 0.68438 | 0.68814 | 0.69596 | 0.70173 | 0.72057 | 0.76336 | 0.80319 | 0.88622 | 0.91927 | 0.94703 |
| 0.95021 | 0.98750 | 1.00484 | 1.06432 | 1.10348 | 1.12922 | 1.14493 | 1.16222 | 1.16375 | 1.18613 |
| 1.19954 | 1.21405 | 1.23366 | 1.24873 | 1.24936 | 1.25926 | 1.26181 | 1.28561 | 1.29475 | 1.41556 |
| 1.42044 | 1.43782 | 1.44911 | 1.49159 | 1.51394 | 1.52948 | 1.54859 | 1.56464 | 1.56788 | 1.58235 |
| 1.60007 | 1.61224 | 1.65830 | 1.68686 | 1.69229 | 1.71577 | 1.71780 | 1.78879 | 1.82642 | 1.85695 |
| 1.88825 | 1.89974 | 1.97699 | 1.97732 | 2.02109 | 2.08303 | 2.10938 | 2.29356 | 2.30364 | 2.39940 |
| 2.43348 | 2.44751 | 2.45968 | 2.47714 | 2.48821 | 2.51308 | 2.53613 | 2.54350 | 2.54883 | 2.60946 |
| 2.62060 | 2.62371 | 2.67289 | 2.76881 | 2.78135 | 2.79080 | 2.96383 | 2.96899 | 2.98502 | 2.98624 |
| 3.06702 | 3.17200 | 3.18687 | 3.29687 | 3.36258 | 3.62201 | 3.64918 | 3.72059 | 3.82919 | 3.83449 |
| 4.05208 | 4.12742 | 4.18185 | 4.33148 | 4.37701 | 4.46792 | 4.76518 | 5.95893 | 6.03645 | 7.46306 |

Группированная выборка (интервальный вариационный ряд):

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| (ai-1,ai] | [-5.69638; -4.05145] | (-4.05145; -2.40652] | (-2.40652; -0.76159] | (-0.76159; 0.88334] | (0.88334; 2.52827] | (2.52827; 4.17320] | (4.17320; 5.81813] | (5.81813; 7.46306] |
| ni | 5 | 22 | 51 | 69 | 59 | 26 | 5 | 3 |
| wi | 0.02083 | 0.09167 | 0.21250 | 0.28750 | 0.24583 | 0.10833 | 0.02083 | 0.01250 |

<math>\sum\_{i=0}^\{N}\w\_i</math> = 1.00000

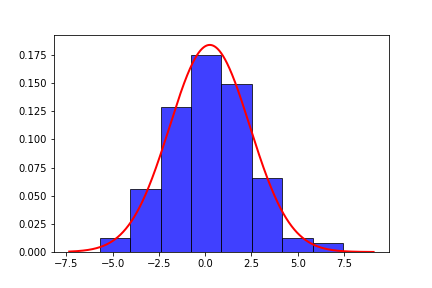
Математическое ожидание: ilde{a} = 0.25278

Дисперсия: ilde{\sigma}^2 = 4.69831

Среднеквадратическое отклонение: ilde{\sigma} = 2.16756

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| k | ak | (ak-a)/s | 1/s\*f((ak-a)/s) | F((ak-a)/s) | pk |
| 0 | -5.69638 | -2.74464 | 0.00426 | 0.00303 | - |
| 1 | -4.05145 | -1.98575 | 0.02563 | 0.02353 | 0.02353 |
| 2 | -2.40652 | -1.22687 | 0.08671 | 0.10994 | 0.08641 |
| 3 | -0.76159 | -0.46798 | 0.16496 | 0.31990 | 0.20996 |
| 4 | 0.88334 | 0.29091 | 0.17643 | 0.61444 | 0.29454 |
| 5 | 2.52827 | 1.04979 | 0.10608 | 0.85309 | 0.23865 |
| 6 | 4.17320 | 1.80868 | 0.03586 | 0.96475 | 0.11166 |
| 7 | 5.81813 | 2.56756 | 0.00681 | 0.99488 | 0.03013 |
| 8 | 7.46306 | 3.32645 | 0.00073 | 0.99956 | 0.00512 |

График плотности нормального распределения, наложенный на гистограмму относительных частот:



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| k | Интервал | wk | pk | |wk-pk| | N(wk-pk)^2/pk |
| 1 | [-5.69638; -4.05145] | 0.02083 | 0.02353 | 0.00270 | 0.07420 |
| 2 | (-4.05145; -2.40652] | 0.09167 | 0.08641 | 0.00526 | 0.07687 |
| 3 | (-2.40652; -0.76159] | 0.21250 | 0.20996 | 0.00254 | 0.00736 |
| 4 | (-0.76159; 0.88334] | 0.28750 | 0.29454 | 0.00704 | 0.04037 |
| 5 | (0.88334; 2.52827] | 0.24583 | 0.23865 | 0.00718 | 0.05182 |
| 6 | (2.52827; 4.17320] | 0.10833 | 0.11166 | 0.00332 | 0.02373 |
| 7 | (4.17320; 5.81813] | 0.02083 | 0.03013 | 0.00930 | 0.68841 |
| 8 | (5.81813; 7.46306] | 0.01250 | 0.00512 | 0.00738 | 2.55207 |
|  |  |  |  | 0.00930 | 3.51483 |

\chi\_B^2 = 3.51483

Задание 2)

a = 0.1

b = 6.1

Полученная выборка:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2.33662 | 2.50828 | 1.66630 | 5.38678 | 1.09030 | 1.86382 | 6.04234 | 5.41240 | 2.15200 | 3.09988 |
| 5.30374 | 4.79674 | 5.30938 | 2.80306 | 1.43584 | 5.19274 | 1.15480 | 4.89412 | 4.25122 | 5.47480 |
| 4.70332 | 1.11598 | 5.75686 | 0.97420 | 2.19292 | 3.46852 | 3.29038 | 0.65212 | 4.47232 | 0.18676 |
| 1.08514 | 0.68488 | 4.09126 | 0.68008 | 2.77966 | 0.40990 | 0.34426 | 1.57318 | 5.61748 | 1.81354 |
| 4.41940 | 4.12180 | 5.54404 | 0.88924 | 5.58634 | 2.77408 | 1.42672 | 4.64356 | 0.64354 | 1.91320 |
| 2.21542 | 2.63830 | 3.46264 | 2.51956 | 4.09936 | 1.99792 | 3.29908 | 1.86334 | 4.56148 | 4.37320 |
| 0.62272 | 4.25872 | 1.07404 | 0.11560 | 0.81292 | 0.95386 | 0.62530 | 0.15256 | 0.42262 | 1.10068 |
| 2.32864 | 2.82106 | 1.17418 | 3.95554 | 6.09910 | 3.98602 | 3.18064 | 1.02418 | 3.55810 | 0.49288 |
| 0.36400 | 4.84030 | 6.03586 | 1.49134 | 3.22066 | 5.96500 | 1.17592 | 4.29484 | 1.97266 | 3.71428 |
| 3.71926 | 2.51284 | 2.84590 | 1.71820 | 4.50520 | 0.90664 | 5.49016 | 5.82808 | 3.35500 | 5.62630 |
| 4.47220 | 4.41628 | 1.07926 | 3.58414 | 2.44366 | 3.59818 | 1.44844 | 2.94280 | 5.00674 | 1.94074 |
| 5.12962 | 3.26620 | 3.23302 | 4.36684 | 4.34326 | 1.29016 | 5.15362 | 5.43586 | 1.94104 | 2.42662 |
| 5.75650 | 4.29238 | 0.38548 | 1.50214 | 4.49188 | 3.47998 | 5.35588 | 2.88550 | 1.10440 | 2.10934 |
| 1.55656 | 1.19278 | 4.65334 | 1.37038 | 3.87436 | 1.20628 | 5.72878 | 2.75620 | 1.72354 | 2.87158 |
| 3.00286 | 3.35656 | 2.24884 | 1.48690 | 0.75106 | 1.35670 | 3.37606 | 1.32880 | 3.46642 | 4.16248 |
| 5.83198 | 4.97080 | 2.14660 | 6.01684 | 1.09186 | 5.60368 | 3.67120 | 2.50120 | 2.66248 | 3.46372 |
| 1.28386 | 0.33046 | 3.45934 | 3.00772 | 1.28230 | 1.08472 | 3.62392 | 4.54540 | 0.91384 | 0.45616 |
| 1.64404 | 5.84644 | 3.68578 | 0.72652 | 3.43978 | 2.44432 | 5.86966 | 0.73414 | 5.58532 | 1.47226 |
| 4.56148 | 5.77528 | 2.33824 | 4.68802 | 4.48900 | 3.98458 | 1.22998 | 0.20626 | 5.56666 | 0.85384 |
| 0.85060 | 0.99196 | 5.45374 | 2.70118 | 3.21154 | 2.25028 | 1.96192 | 2.71528 | 1.61818 | 1.70806 |
| 4.18402 | 4.04176 | 0.33556 | 5.46544 | 0.69028 | 0.54220 | 0.84628 | 2.61124 | 4.89088 | 5.33284 |
| 3.82330 | 4.70002 | 2.63884 | 2.85994 | 2.21944 | 0.13642 | 1.16926 | 1.26466 | 4.68154 | 1.15846 |
| 0.15004 | 4.33942 | 1.68562 | 1.37824 | 1.25956 | 0.52528 | 3.41962 | 1.67278 | 4.35226 | 2.29726 |
| 4.55758 | 3.34534 | 1.56112 | 3.42082 | 3.92314 | 5.35522 | 3.40930 | 1.90558 | 5.77156 | 4.67368 |

Упорядоченная выборка:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0.11560 | 0.13642 | 0.15004 | 0.15256 | 0.18676 | 0.20626 | 0.33046 | 0.33556 | 0.34426 | 0.36400 |
| 0.38548 | 0.40990 | 0.42262 | 0.45616 | 0.49288 | 0.52528 | 0.54220 | 0.62272 | 0.62530 | 0.64354 |
| 0.65212 | 0.68008 | 0.68488 | 0.69028 | 0.72652 | 0.73414 | 0.75106 | 0.81292 | 0.84628 | 0.85060 |
| 0.85384 | 0.88924 | 0.90664 | 0.91384 | 0.95386 | 0.97420 | 0.99196 | 1.02418 | 1.07404 | 1.07926 |
| 1.08472 | 1.08514 | 1.09030 | 1.09186 | 1.10068 | 1.10440 | 1.11598 | 1.15480 | 1.15846 | 1.16926 |
| 1.17418 | 1.17592 | 1.19278 | 1.20628 | 1.22998 | 1.25956 | 1.26466 | 1.28230 | 1.28386 | 1.29016 |
| 1.32880 | 1.35670 | 1.37038 | 1.37824 | 1.42672 | 1.43584 | 1.44844 | 1.47226 | 1.48690 | 1.49134 |
| 1.50214 | 1.55656 | 1.56112 | 1.57318 | 1.61818 | 1.64404 | 1.66630 | 1.67278 | 1.68562 | 1.70806 |
| 1.71820 | 1.72354 | 1.81354 | 1.86334 | 1.86382 | 1.90558 | 1.91320 | 1.94074 | 1.94104 | 1.96192 |
| 1.97266 | 1.99792 | 2.10934 | 2.14660 | 2.15200 | 2.19292 | 2.21542 | 2.21944 | 2.24884 | 2.25028 |
| 2.29726 | 2.32864 | 2.33662 | 2.33824 | 2.42662 | 2.44366 | 2.44432 | 2.50120 | 2.50828 | 2.51284 |
| 2.51956 | 2.61124 | 2.63830 | 2.63884 | 2.66248 | 2.70118 | 2.71528 | 2.75620 | 2.77408 | 2.77966 |
| 2.80306 | 2.82106 | 2.84590 | 2.85994 | 2.87158 | 2.88550 | 2.94280 | 3.00286 | 3.00772 | 3.09988 |
| 3.18064 | 3.21154 | 3.22066 | 3.23302 | 3.26620 | 3.29038 | 3.29908 | 3.34534 | 3.35500 | 3.35656 |
| 3.37606 | 3.40930 | 3.41962 | 3.42082 | 3.43978 | 3.45934 | 3.46264 | 3.46372 | 3.46642 | 3.46852 |
| 3.47998 | 3.55810 | 3.58414 | 3.59818 | 3.62392 | 3.67120 | 3.68578 | 3.71428 | 3.71926 | 3.82330 |
| 3.87436 | 3.92314 | 3.95554 | 3.98458 | 3.98602 | 4.04176 | 4.09126 | 4.09936 | 4.12180 | 4.16248 |
| 4.18402 | 4.25122 | 4.25872 | 4.29238 | 4.29484 | 4.33942 | 4.34326 | 4.35226 | 4.36684 | 4.37320 |
| 4.41628 | 4.41940 | 4.47220 | 4.47232 | 4.48900 | 4.49188 | 4.50520 | 4.54540 | 4.55758 | 4.56148 |
| 4.56148 | 4.64356 | 4.65334 | 4.67368 | 4.68154 | 4.68802 | 4.70002 | 4.70332 | 4.79674 | 4.84030 |
| 4.89088 | 4.89412 | 4.97080 | 5.00674 | 5.12962 | 5.15362 | 5.19274 | 5.30374 | 5.30938 | 5.33284 |
| 5.35522 | 5.35588 | 5.38678 | 5.41240 | 5.43586 | 5.45374 | 5.46544 | 5.47480 | 5.49016 | 5.54404 |
| 5.56666 | 5.58532 | 5.58634 | 5.60368 | 5.61748 | 5.62630 | 5.72878 | 5.75650 | 5.75686 | 5.77156 |
| 5.77528 | 5.82808 | 5.83198 | 5.84644 | 5.86966 | 5.96500 | 6.01684 | 6.03586 | 6.04234 | 6.09910 |

Группированная выборка (интервальный вариационный ряд):

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| (ai-1,ai] | [0.10000; 0.85000] | (0.85000; 1.60000] | (1.60000; 2.35000] | (2.35000; 3.10000] | (3.10000; 3.85000] | (3.85000; 4.60000] | (4.60000; 5.35000] | (5.35000; 6.10000] |
| ni | 29 | 45 | 30 | 26 | 30 | 31 | 19 | 30 |
| wi | 0.12083 | 0.18750 | 0.12500 | 0.10833 | 0.12500 | 0.12917 | 0.07917 | 0.12500 |

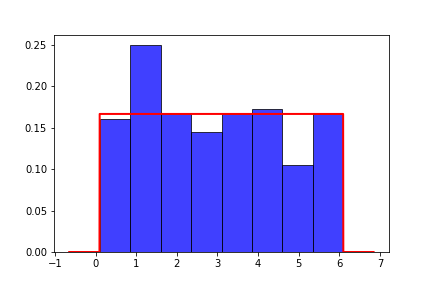
<math>\sum\_{i=0}^\{N}\w\_i</math> = 1.00000

Математическое ожидание: ilde{a} = 2.91875

Дисперсия: ilde{\sigma}^2 = 2.90621

Среднеквадратическое отклонение: ilde{\sigma} = 1.70476

График плотности равномерного распределения, наложенный на гистограмму относительных частот:



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| k | Интервал | wk | pk | |wk-pk| | N(wk-pk)^2/pk |
| 1 | [0.10000; 0.85000] | 0.12083 | 0.12500 | 0.00417 | 0.03333 |
| 2 | (0.85000; 1.60000] | 0.18750 | 0.12500 | 0.06250 | 7.50000 |
| 3 | (1.60000; 2.35000] | 0.12500 | 0.12500 | 0.00000 | 0.00000 |
| 4 | (2.35000; 3.10000] | 0.10833 | 0.12500 | 0.01667 | 0.53333 |
| 5 | (3.10000; 3.85000] | 0.12500 | 0.12500 | 0.00000 | 0.00000 |
| 6 | (3.85000; 4.60000] | 0.12917 | 0.12500 | 0.00417 | 0.03333 |
| 7 | (4.60000; 5.35000] | 0.07917 | 0.12500 | 0.04583 | 4.03333 |
| 8 | (5.35000; 6.10000] | 0.12500 | 0.12500 | 0.00000 | 0.00000 |
|  |  |  |  | 0.06250 | 12.13333 |

\chi\_B^2 = 12.13333

Анализ результатов и выводы

Таблица критических значений:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| l | 4 | 5 | 6 | 7 | 8 |
| chi | 9.5 | 11.1 | 12.6 | 14.1 | 15.5 |

1) Нормальное распределение

\chi\_B^2 = 3.51483

chi(5) = 11.1

Гипотеза о соответствии выборки нормальному распределению не противоречит экспериментальным данным (т.е. может быть принята) при уровне значимости alpha = 0,05.

2) Равномерное распределение

\chi\_B^2 = 12.13333

chi(5) = 11.1

Гипотеза о соответствии выборки нормальному распределению противоречит экспериментальным данным (т.е. не может быть принята) при уровне значимости alpha = 0,05.