*Testowanie hipotez statystycznych*

**Zadanie 1:** Firma doradztwa inwestycyjnego zapewnia, że przeciętna stopa zwrotu z akcji w pewnej branży wynosi **11.5%**. Inwestor chce sprawdzić tę opinię. Pobiera próbę złożoną z akcji **50** spółek należących do danej branży. Na podstawie danych z próby stwierdza, że średnia stopa zwrotu z akcji wynosi **10.4%**, przy odchyleniu standardowym **3.4%**. Czy inwestor ma dostateczne podstawy do odrzucenia zapewnienia firmy doradczej na poziomie istotności **0.05**?

**Zadanie 2:** Kierownictwo pewnej firmy ubezpieczeniowej wysunęło przypuszczenie, że średnie wypłaty ponoszone z tytułu odszkodowań popowodziowych przekraczają kwotę **2 mln zł**. Przeanalizowano dane dotyczące wysokości odszkodowań poniesionych przez tę firmę podczas **5** kolejnych powodzi. Ustalono, że łączne kwoty odszkodowań popowodziowych wypłaconych w rozważanych okresach wynosiły odpowiednio (w mln zł): **1.9; 3.7; 2.9; 2.0; 3.3**. Czy można przyjąć, że kierownictwo firmy ma racje? Zweryfikować odpowiednią hipotezę na poziomie istotności **α = 0.05**, zakładając, że rozkład wysokości odszkodowań popowodziowych jest normalny.

**Zadanie 3:** Ustalono na podstawie analizy kosztów, że budowa motelu przy trasie komunikacyjnej będzie opłacalna, jeśli będzie tą trasą przejeżdżać więcej niż **800** samochodów dziennie. W losowe wybrane dni roku liczono ilość przejeżdżających samochodów. Otrzymano następujące rezultaty: **792, 810, 820, 886, 910, 840, 1025, 790, 972, 830, 810, 780, 815, 954, 810, 930, 820**. Na poziomie istotności **0.05** zweryfikuj hipotezę o opłacalności podejmowanej inwestycji.

***Dystrybuanta Φ(x) rozkładu normalnego (0,1)***

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***x*** | ***0*** | ***0.01*** | ***0.02*** | ***0.03*** | ***0.04*** | ***0.05*** | ***0.06*** | ***0.07*** | ***0.08*** | ***0.09*** |
| ***0*** | *0.500000* | *0.503989* | *0.507978* | *0.511966* | *0.515953* | *0.519939* | *0.523922* | *0.527903* | *0.531881* | *0.535856* |
| ***0.1*** | *0.539828* | *0.543795* | *0.547758* | *0.551717* | *0.555670* | *0.559618* | *0.563559* | *0.567495* | *0.571424* | *0.575345* |
| ***0.2*** | *0.579260* | *0.583166* | *0.587064* | *0.590954* | *0.594835* | *0.598706* | *0.602568* | *0.606420* | *0.610261* | *0.614092* |
| ***0.3*** | *0.617911* | *0.621720* | *0.625516* | *0.629300* | *0.633072* | *0.636831* | *0.640576* | *0.644309* | *0.648027* | *0.651732* |
| ***0.4*** | *0.655422* | *0.659097* | *0.662757* | *0.666402* | *0.670031* | *0.673645* | *0.677242* | *0.680822* | *0.684386* | *0.687933* |
| ***0.5*** | *0.691462* | *0.694974* | *0.698468* | *0.701944* | *0.705401* | *0.708840* | *0.712260* | *0.715661* | *0.719043* | *0.722405* |
| ***0.6*** | *0.725747* | *0.729069* | *0.732371* | *0.735653* | *0.738914* | *0.742154* | *0.745373* | *0.748571* | *0.751748* | *0.754903* |
| ***0.7*** | *0.758036* | *0.761148* | *0.764238* | *0.767305* | *0.770350* | *0.773373* | *0.776373* | *0.779350* | *0.782305* | *0.785236* |
| ***0.8*** | *0.788145* | *0.791030* | *0.793892* | *0.796731* | *0.799546* | *0.802337* | *0.805105* | *0.807850* | *0.810570* | *0.813267* |
| ***0.9*** | *0.815940* | *0.818589* | *0.821214* | *0.823814* | *0.826391* | *0.828944* | *0.831472* | *0.833977* | *0.836457* | *0.838913* |
| ***1.0*** | *0.841345* | *0.843752* | *0.846136* | *0.848495* | *0.850830* | *0.853141* | *0.855428* | *0.857690* | *0.859929* | *0.862143* |
| ***1.1*** | *0.864334* | *0.866500* | *0.868643* | *0.870762* | *0.872857* | *0.874928* | *0.876976* | *0.879000* | *0.881000* | *0.882977* |
| ***1.2*** | *0.884930* | *0.886861* | *0.888768* | *0.890651* | *0.892512* | *0.894350* | *0.896165* | *0.897958* | *0.899727* | *0.901475* |
| ***1.3*** | *0.903200* | *0.904902* | *0.906582* | *0.908241* | *0.909877* | *0.911492* | *0.913085* | *0.914657* | *0.916207* | *0.917736* |
| ***1.4*** | *0.919243* | *0.920730* | *0.922196* | *0.923641* | *0.925066* | *0.926471* | *0.927855* | *0.929219* | *0.930563* | *0.931888* |
| ***1.5*** | *0.933193* | *0.934478* | *0.935745* | *0.936992* | *0.938220* | *0.939429* | *0.940620* | *0.941792* | *0.942947* | *0.944083* |
| ***1.6*** | *0.945201* | *0.946301* | *0.947384* | *0.948449* | *0.949497* | *0.950529* | *0.951543* | *0.952540* | *0.953521* | *0.954486* |
| ***1.7*** | *0.955435* | *0.956367* | *0.957284* | *0.958185* | *0.959070* | *0.959941* | *0.960796* | *0.961636* | *0.962462* | *0.963273* |
| ***1.8*** | *0.964070* | *0.964852* | *0.965620* | *0.966375* | *0.967116* | *0.967843* | *0.968557* | *0.969258* | *0.969946* | *0.970621* |
| ***1.9*** | *0.971283* | *0.971933* | *0.972571* | *0.973197* | *0.973810* | *0.974412* | *0.975002* | *0.975581* | *0.976148* | *0.976705* |
| ***2.0*** | *0.977250* | *0.977784* | *0.978308* | *0.978822* | *0.979325* | *0.979818* | *0.980301* | *0.980774* | *0.981237* | *0.981691* |
| ***2.1*** | *0.982136* | *0.982571* | *0.982997* | *0.983414* | *0.983823* | *0.984222* | *0.984614* | *0.984997* | *0.985371* | *0.985738* |
| ***2.2*** | *0.986097* | *0.986447* | *0.986791* | *0.987126* | *0.987455* | *0.987776* | *0.988089* | *0.988396* | *0.988696* | *0.988989* |
| ***2.3*** | *0.989276* | *0.989556* | *0.989830* | *0.990097* | *0.990358* | *0.990613* | *0.990863* | *0.991106* | *0.991344* | *0.991576* |
| ***2.4*** | *0.991802* | *0.992024* | *0.992240* | *0.992451* | *0.992656* | *0.992857* | *0.993053* | *0.993244* | *0.993431* | *0.993613* |
| ***2.5*** | *0.993790* | *0.993963* | *0.994132* | *0.994297* | *0.994457* | *0.994614* | *0.994766* | *0.994915* | *0.995060* | *0.995201* |
| ***2.6*** | *0.995339* | *0.995473* | *0.995604* | *0.995731* | *0.995855* | *0.995975* | *0.996093* | *0.996207* | *0.996319* | *0.996427* |
| ***2.7*** | *0.996533* | *0.996636* | *0.996736* | *0.996833* | *0.996928* | *0.997020* | *0.997110* | *0.997197* | *0.997282* | *0.997365* |
| ***2.8*** | *0.997445* | *0.997523* | *0.997599* | *0.997673* | *0.997744* | *0.997814* | *0.997882* | *0.997948* | *0.998012* | *0.998074* |
| ***2.9*** | *0.998134* | *0.998193* | *0.998250* | *0.998305* | *0.998359* | *0.998411* | *0.998462* | *0.998511* | *0.998559* | *0.998605* |
| ***3.0*** | *0.998650* | *0.998694* | *0.998736* | *0.998777* | *0.998817* | *0.998856* | *0.998893* | *0.998930* | *0.998965* | *0.998999* |

***Rozkład t - Studenta***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Wartość α | **0,9** | **0,8** | **0,7** | **0,6** | **0,5** | **0,4** | **0,3** | **0,2** | **0,1** | **0,05** | **0,04** | **0,02** | **0,01** | **0,001** |
| Stopnie swobody |
| **1** | 0,158 | 0,325 | 0,510 | 0,727 | 1,000 | 1,376 | 1,963 | 3,078 | 6,314 | 12,70 | 15,89 | 31,82 | 63,65 | 636,5 |
| **2** | 0,142 | 0,289 | 0,445 | 0,617 | 0,816 | 1,061 | 1,386 | 1,886 | 2,920 | 4,303 | 4,849 | 6,965 | 9,925 | 31,60 |
| **3** | 0,137 | 0,277 | 0,424 | 0,584 | 0,765 | 0,978 | 1,250 | 1,638 | 2,353 | 3,182 | 3,482 | 4,541 | 5,841 | 12,92 |
| **4** | 0,134 | 0,271 | 0,414 | 0,569 | 0,741 | 0,941 | 1,190 | 1,533 | 2,132 | 2,776 | 2,999 | 3,747 | 4,604 | 8,610 |
| **5** | 0,132 | 0,267 | 0,408 | 0,559 | 0,727 | 0,920 | 1,156 | 1,476 | 2,015 | 2,571 | 2,757 | 3,365 | 4,032 | 6,869 |
| **6** | 0,131 | 0,265 | 0,404 | 0,553 | 0,718 | 0,906 | 1,134 | 1,440 | 1,943 | 2,447 | 2,612 | 3,143 | 3,707 | 5,959 |
| **7** | 0,130 | 0,263 | 0,402 | 0,549 | 0,711 | 0,896 | 1,119 | 1,415 | 1,895 | 2,365 | 2,517 | 2,998 | 3,499 | 5,408 |
| **8** | 0,130 | 0,262 | 0,399 | 0,546 | 0,706 | 0,889 | 1,108 | 1,397 | 1,860 | 2,306 | 2,449 | 2,896 | 3,355 | 5,041 |
| **9** | 0,129 | 0,261 | 0,398 | 0,543 | 0,703 | 0,883 | 1,100 | 1,383 | 1,833 | 2,262 | 2,398 | 2,821 | 3,250 | 4,781 |
| **10** | 0,129 | 0,260 | 0,397 | 0,542 | 0,700 | 0,879 | 1,093 | 1,372 | 1,812 | 2,228 | 2,359 | 2,764 | 3,169 | 4,587 |
| **11** | 0,129 | 0,260 | 0,396 | 0,540 | 0,697 | 0,876 | 1,088 | 1,363 | 1,796 | 2,201 | 2,328 | 2,718 | 3,106 | 4,437 |
| **12** | 0,128 | 0,259 | 0,395 | 0,539 | 0,695 | 0,873 | 1,083 | 1,356 | 1,782 | 2,179 | 2,303 | 2,681 | 3,055 | 4,318 |
| **13** | 0,128 | 0,259 | 0,394 | 0,538 | 0,694 | 0,870 | 1,079 | 1,350 | 1,771 | 2,160 | 2,282 | 2,650 | 3,012 | 4,221 |
| **14** | 0,128 | 0,258 | 0,393 | 0,537 | 0,692 | 0,868 | 1,076 | 1,345 | 1,761 | 2,145 | 2,264 | 2,624 | 2,977 | 4,140 |
| **15** | 0,128 | 0,258 | 0,393 | 0,536 | 0,691 | 0,866 | 1,074 | 1,341 | 1,753 | 2,131 | 2,249 | 2,602 | 2,947 | 4,073 |
| **16** | 0,128 | 0,258 | 0,392 | 0,535 | 0,690 | 0,865 | 1,071 | 1,337 | 1,746 | **2,120** | 2,235 | 2,583 | 2,921 | 4,015 |
| **17** | 0,128 | 0,257 | 0,392 | 0,534 | 0,689 | 0,863 | 1,069 | 1,333 | 1,740 | 2,110 | 2,224 | 2,567 | 2,898 | 3,965 |
| **18** | 0,127 | 0,257 | 0,392 | 0,534 | 0,688 | 0,862 | 1,067 | 1,330 | 1,734 | 2,101 | 2,214 | 2,552 | 2,878 | 3,922 |
| **19** | 0,127 | 0,257 | 0,391 | 0,533 | 0,688 | 0,861 | 1,066 | 1,328 | 1,729 | 2,093 | 2,205 | 2,539 | 2,861 | 3,883 |
| **20** | 0,127 | 0,257 | 0,391 | 0,533 | 0,687 | 0,860 | 1,064 | 1,325 | 1,725 | 2,086 | 2,197 | 2,528 | 2,845 | 3,850 |
| **21** | 0,127 | 0,257 | 0,391 | 0,532 | 0,686 | 0,859 | 1,063 | 1,323 | 1,721 | 2,080 | 2,189 | 2,518 | 2,831 | 3,819 |
| **22** | 0,127 | 0,256 | 0,390 | 0,532 | 0,686 | 0,858 | 1,061 | 1,321 | 1,717 | 2,074 | 2,183 | 2,508 | 2,819 | 3,792 |
| **23** | 0,127 | 0,256 | 0,390 | 0,532 | 0,685 | 0,858 | 1,060 | 1,319 | 1,714 | 2,069 | 2,177 | 2,500 | 2,807 | 3,768 |
| **24** | 0,127 | 0,256 | 0,390 | 0,531 | 0,685 | 0,857 | 1,059 | 1,318 | 1,711 | 2,064 | 2,172 | 2,492 | 2,797 | 3,745 |
| **25** | 0,127 | 0,256 | 0,390 | 0,531 | 0,684 | 0,856 | 1,058 | 1,316 | 1,708 | 2,060 | 2,167 | 2,485 | 2,787 | 3,725 |
| **26** | 0,127 | 0,256 | 0,390 | 0,531 | 0,684 | 0,856 | 1,058 | 1,315 | 1,706 | 2,056 | 2,162 | 2,479 | 2,779 | 3,707 |
| **27** | 0,127 | 0,256 | 0,389 | 0,531 | 0,684 | 0,855 | 1,057 | 1,314 | 1,703 | 2,052 | 2,158 | 2,473 | 2,771 | 3,689 |
| **28** | 0,127 | 0,256 | 0,389 | 0,530 | 0,683 | 0,855 | 1,056 | 1,313 | 1,701 | 2,048 | 2,154 | 2,467 | 2,763 | 3,674 |
| **29** | 0,127 | 0,256 | 0,389 | 0,530 | 0,683 | 0,854 | 1,055 | 1,311 | 1,699 | 2,045 | 2,150 | 2,462 | 2,756 | 3,660 |
| **30** | 0,127 | 0,256 | 0,389 | 0,530 | 0,683 | 0,854 | 1,055 | 1,310 | 1,697 | 2,042 | 2,147 | 2,457 | 2,750 | 3,646 |